SCHOOL SCIENCE

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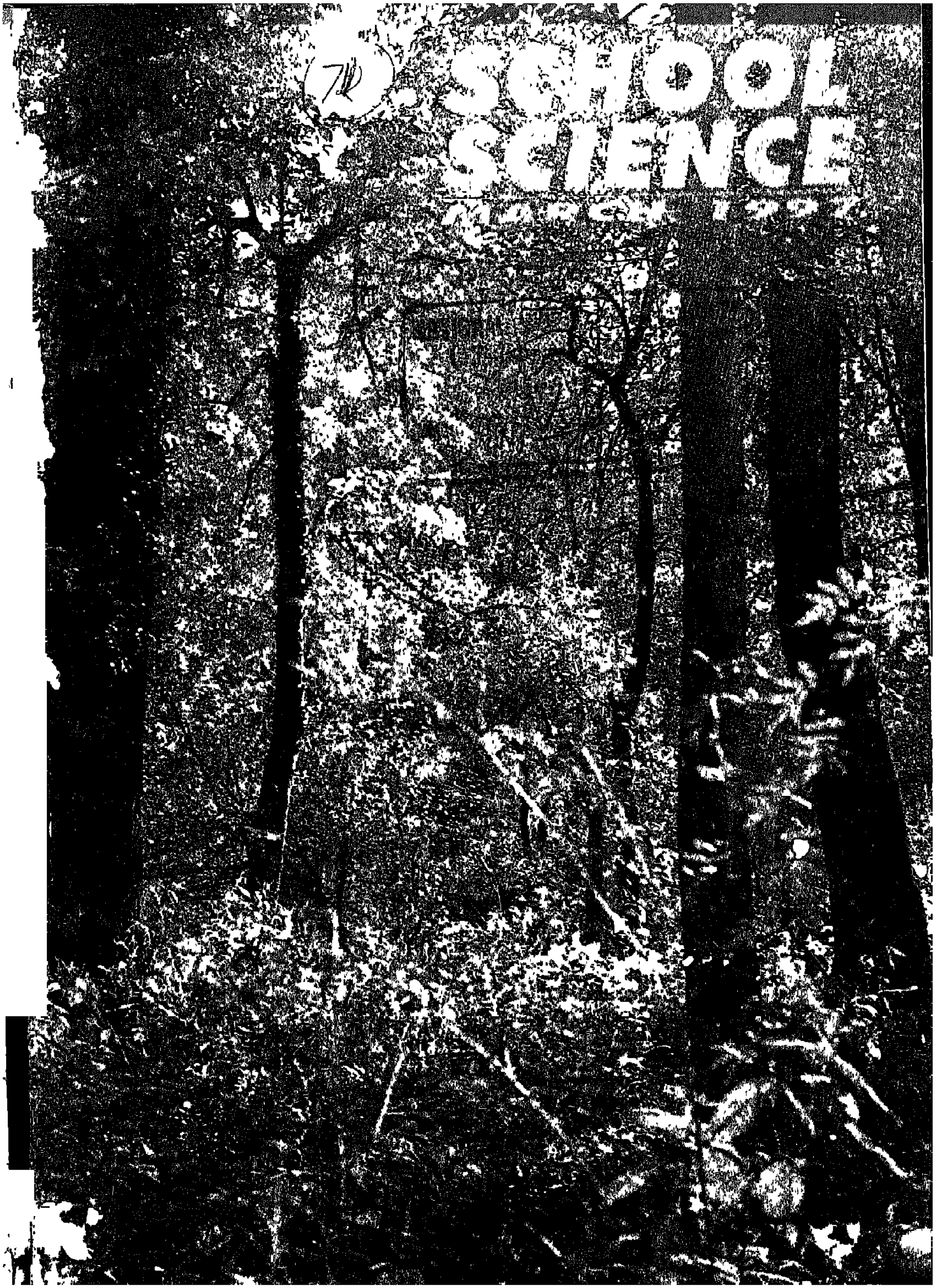

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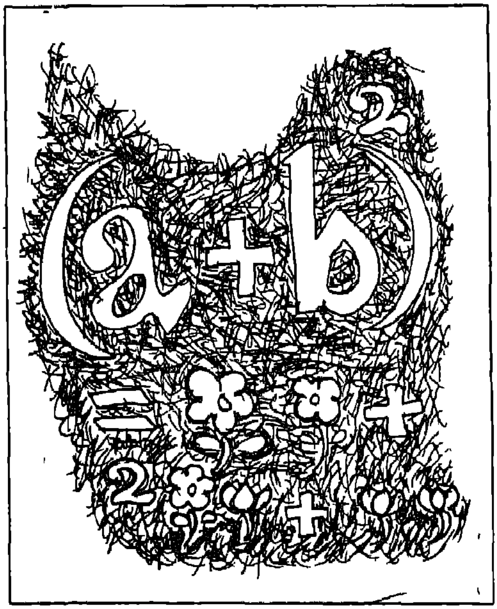
JIE invites articles/papers on the impact of educational research on classroom practices and policy decisions. Specific examples where this impact is apparent may be given.

— ACADEMIC EDITOR

Psychology in Teaching Mathematics

MARLOW EDIGER
Professor of Education
Route 2, Box 38
Kirksville
Missouri 63501 (USA)



Mathematics teachers need to study diverse psychologies of learning so that individual learners may be guided to attain as optimally as possible. With a thorough knowledge of the psychology of learning, teachers may do a better job of teaching mathematics to pupils of all ability levels. Individual differences among the learners must be provided for in order that each pupil may learn as much mathematics as possible. A quality mathematics teacher emphasizes objectives, learning opportunities, and appraisal procedures that assist pupils individually to perceive meaning in the mathematics curriculum.

Meaning Theory in Teaching Mathematics

Mathematics teachers need to be certain that each pupil attaches meaning to facts, concepts, and generalizations acquired in the curriculum. With meaningful subject matter, pupils may understand that which was taught. Understanding content presented in mathematics assists the pupil to clarify information. Clarity of understanding stress that pupils comprehend subject matter presented. In deductive teaching, the teacher explains each fact, concept, and generalization so that meaningful learning may accrue. When induction as a method of instruction is used, the mathematics teacher asks numerous questions of pupils to receive feedback if they understand what was taught. I believe that teachers must spend adequate time in guiding pupils to perceive meaning, deductively and inductively, through the use of concrete, semiconcrete, and abstract materials of instruction in terms of content taught.

Directly related to pupils' attaching meaning to ongoing content presented, the learner must be able to use subject matter acquired. If the subject matter acquired is used, the chances are it will be retained better than if it were not used The teacher should assist pupils to apply facts, concepts, and generalizations acquired. Thus information can be used in solving word problems from the basal textbook used in the classroom Pupils may also use previously acquired content when solving life-like problems in mathematics The teacher might write problems and photocopy them for the learners to respond to. These problems are directly related to what has been taught in ongoing lessons and units in mathematics Learners too may write problems and exchange papers with others to solve each problem so that application can be made of what has been learned previously Discussions led by the teacher can also get pupils wholeheartedly involved in making use of the subject matter learned

The mathematics teacher needs to guide the learners to engage in higher levels of cognition when using meaningful materials for the learners Thus pupils need to have opportunities to engage in critical thinking. In separating the relevant from the irrelevant in working to secure answers to a word problem in mathematics involves critical thought. A separation then of what is salient as compared to that which is not important is necessary in critical thinking. That which is significant is then used to obtain an answer to a word problem contained in the basal or written by the teacher or a learner Life in society demands that pupils become proficient now and in the future as an adult in the area of critical thought Separating reality from fantasy and the real from that which is imaginary are necessary ingredients in critical thinking

Novel solutions are needed to solve numerous problems Creative thinking then needs adequate emphasis in the mathematics curriculum. For example, to solve a word problem, several algorithms may be used to arrive at an answer Each algorithm might well provide the correct answer. The learners should become familiar with diversity involved here so that the algorithm that works best for the pupils may be used Unique solutions to word problems should assist pupils to explore different options to each problem in the societal arena. Hopefully, this transfer from the mathematics curriculum to the real world of society will be in evidence. In society, individuals meet up with unique situations in which solutions are needed that are different from any solution used in the past.

Life-like problems actually faced by the learners in mathematics, need adequate emphasis in the curriculum. These problems involve buying and selling items, how to stay within one's own budget, as well as an increased use of mathematics in society emphasize problem solving involving reality. A creative mind may be necessary presently for the pupil as well as in the future to solve these problems involving mathematics. Creative thinking must be a definite goal in the mathematics curriculum. Critical thought is also necessary for pupils in solving life-like problems in mathematics. Comparing solutions in answer to a problem certainly stresses critical thought Further situations involving critical thought emphasizes analyzing a problem in mathematics to study component parts After comparing and analyzing possible solutions in dealing with problems in mathematics in the real world, a synthesis is needed To synthesize, creative thinking again is in evidence Synthesizing emphasizes securing wholeness in coming up with a solution to a problem area. Steps inherent in solving life-like problems (or word problems) in mathematics include the following ·

1 Defining the problem whereby clarity is in evidence
2 Gathering information in arriving at a tentative solution
3 Developing a hypothesis based on the acquired information
4 Testing the hypothesis in step three above
5 Revising the hypothesis, if needed

In addition to pupils attaching meaning to what has been learned, applying that which has been learned, and engaging in higher levels of cognition, pupils also need to perceive purpose in learning in ongoing lessons and units of study in mathematics There are selected approaches which can be used by the mathematics teacher to guide pupils to perceive purpose for achieving A deductive procedure might be used. With deduction, the mathematics teacher explains to the learners why the subject matter to be studied is relevant I believe that the small amount of time needed to explain to the learners why the subject matter to be acquired is salient, is time well spent in teaching and learning situations Instead of a deductive approach in guiding pupils to perceive purpose or reasons for learning, there are teachers who prefer an inductive approach. Here, the mathematics teacher asks questions of pupils as to why they believe the content to be studied is relevant to learn Inductive procedures are more time consuming as compared to deduction since responses must come from the learners when determining the relevance in studying vital facts, concepts, and generalizations in mathematics

A third approach in guiding pupils to perceive purpose in learning is to use extrinsic rewards Here, the mathematics teachers needs to announce prior to instruction what pupils are to learn as well as the reward that will accrue to the learners if they achieve this goal Rewards to be given might be inexpensive prizes, token to be exchanged for prizes, time given for a self-selected activity, or extra recess time The reward must motivate pupils to achieve more optimally in mathematics It is given to pupils only if they have attained a goal announced by the teacher prior to lesson presentation. The amount of learning that must be acquired before the pupil secures the reward is determined by the teacher. The working for the reward is a motivator for the learner Receiving the reward for goal attainment is a reinforcer to encourage similar future behaviour.

Interest is a powerful factor in learning. The mathematics teacher needs to obtain the attention of all the learners during teaching-leaning situations To demand attention of pupils does not capture learner interest in mathematics Rather, the teacher needs to use a variety of materials in teaching mathematics to obtain intrinsic interest of the learners These activities include life-like problems which need solution, textbook and workbook assignments, films, slide, video tapes, video disks, illustrations, teaching aids' technology, integrated learning systems, teaching units, as well as resource units of study in mathematics In using a variety of learning activities, the mathematics teacher has a better chance in securing learner interest as compared to a single type of material The tone of the teacher's voice must have appropriate voice inflection, pitch and juncture A monotonous tone of voice will not tend to obtain learner interest and attention Quality eye contact with pupils should aid in obtaining pupil attention and promote learning in mathematics Interest of pupils in ongoing lessons and units of study develops effort for achieving.

Theories of Learning in Mathematics

Selected theories of learning in educational psychology used by the teacher should assist pupils to attain at a more optimal level. Operant conditioning, as developed by B.F Skinner (1904-1988), has done much as a theory of learning to guide learner progress Dr Skinner stressed the used of programmed learning in emphasizing behaviorism as a psychology of learning. Here, a qualified programmer would determine what pupils are to learn in any unit of study in mathematics The body of knowledge within the unit is broken down into component parts The steps of attainment are very small when working on a programme in mathematics, be it in textbook or in software form The pupil, here generally reads a sentence or two, depending on the maturity level of the involved learner He/she then views a related illustration, responds to a test item, and checks the response. If correct, the pupil is rewarded. If incorrect, the pupil now knows the correct answer and is also ready for the next sequential programmed item The programme has been tried out previously in pilot studies with needed modifications made The content to follow in each programme moves from the simple to the increasingly more complex. The same procedure, or a slight modification, may follow in each step of learning such as 'read a sentence or more', view an illustration, 'respond to a test item' Answers given by the learner are either correct or incorrect By being correct approximately 90 per cent of the time in responding, the pupil can make continuous progress with increasingly complex items in programmed learning. A positive self concept could be an end-result for pupils if they respond with an approximate 90 per cent correct in terms of accuracy Tutorial programmes using computers tend to stress tenets of programmed instruction Simulation in computer use may also stress programmed learning, providing it is not too open-ended in its subject matter presentation B F Skinner believed strongly in answers being either right or wrong when the learners make responses. Shankaranarayana wrote .

For Skinner (1969), "teaching is an arrangement of contingencies of reinforcement which expedite learning". Skinner believes that promotion of learning is possible by giving attention to the following factors the behaviour that is to be learned, the reinforcers that may be used and the scheduling of reinforcers

Skinner recommends the use of programmed instruction which provides for individual differences by allowing students to achieve at their own rate of speed In terms of Skinner' operant behaviorism, "a programme can be seen as an arrangement of material that will lead students to emit correct responses and will also provide reinforcement for that response The essential elements of programmed instruction are · (1) an ordered sequence of stimuli, (2) specific student response, (3) immediate knowledge of results, (4) small steps, (5) minimum errors, (6) gradual shaping of terminal behaviour and (7) self pacing

B F Skinner has a well known and popular name in education. His experiments in teaching and education have indeed been numerous. Morris and Pai (1976) wrote the following

As Skinner has pointed out several times, the most important task on the teacher is to arrange conditions under which desired learning can occur. Considering the fact that teachers are to bring about changes in extremely complex behaviour, they should be specialists in human behaviour. Effective and efficient manipulation of the multitude of variable affecting children's intellectual and social behaviors cannot be accomplished by trial and error alone, nor should such work be based solely on the personal experiences of the teacher, since this covers only a limited range of circumstances Consequently, a scientific study of human behaviour is vital in the improvement of teaching, because it provides us with accurate and reliable knowledge about learning and leads to the development of new instructional materials, methods, and techniques Similarly, an empirical analysis of the teaching process is essential, for it clarifies the teacher's responsibility through a series of small and progressive approximations. This approach makes teaching practices more specific, thereby facilitating a more effective evaluation.

James Popham and Behaviourism

James Popham from the University of California is a strong advocate of behaviourism Dr. Popham (1970) (see bibliography entries) developed a series of filmstrips and related cassette tapes proposing behaviourism as a needed central theme of teaching and learning Behaviourists believe strongly in the use of measurably stated objectives in teaching pupils These precise objectives are written prior to teaching learners Ideally, there is no leeway in determining what will be taught when viewing the written statement of objectives The teacher then is certain as to what will be taught He/she may announce to pupils that which will be taught before teaching and learning. Pupils then know what is required of them in terms of subject matter to be acquired Learners need not out-guess the teacher to realize what is expected as to the precise objectives to be achieved

According to Popham, the learning opportunities chosen by the teacher must contain only that which is in the stated objective(s), no more and no less Evaluation of pupil attainment in mathematics needs to be done in terms of the measurably stated objectives. Thus a very close alignment indeed is in the offing among the objectives, the learning opportunities, and the evaluation procedures Validity a measurement term, is in evidence if the evaluation techniques harmonize with the stated objectives in mathematics

James Popham with his stress

placed upon behaviourism as a psychology of instruction in teaching mathematics advocates the following :

1 Vague hazy objectives need to be eliminated or rewritten so that a sharp focus exists in terms of what will be taught
2 Learning opportunities must be very carefully chosen since each needs to guide pupils to attain that which is in the stated objective
3 Evaluation procedures should ascertain if each pupil has attained the precise objectives
4. A different teaching strategy needs to be used if a learner did not achieve an objective
5 Sequence of objectives is arranged by the mathematics teacher

Dr. Popham places extremely strong emphasis upon choosing precise, measurable stated objectives for instruction He places little stress upon choosing learning opportunities, except that they should match up very precisely with the stated objectives. Evaluation is done strictly in terms of what is mentioned specifically in each objective for pupil attainment

Robert Gagne' and Task Analysis of Objectives

Robert Gagne (1984) is a leading psychologist in education who recommends a behaviouristic approach in teaching: however his thinking is more open-ended as compared to Drs Skinner and Popham. Gagne's eight sequential steps of hierarchical learning for pupils may be of considerable help to teachers in planning the mathematics curriculum. The right steps of sequential learning for pupils are the following: signal learning, stimulus-response, chaining, verbal association learning, multiple discrimination, concept learning rule learning, and problem solving as being the most complex form of achievement Gagne' was a former mathematics instructor and found task analysis as being a very appropriate way of determining sequence for pupils I will comment on a few of the levels I believe to be especially relevant in teaching: Stimulus-response psychology is very relevant for mathematics teachers to consider For example, once pupils attach meaning through the use of manipulative materials that 7+6 and 6+7 = 13, this addition fact may be committed to memory Thus on a flash card or computer programme the stimulus is 7+6 or 6+7 = . ..If correct, pupils should respond with the answer being 13 Drill and practice should not be used prior to meaningful learning by pupils But, once meaning is there, pupils may need to associate the stimulus and the response in a somewhat rote manner Gagne's step of chaining might involve pupils using a series of concrete and semiconcrete materials to indicate and show that 7+6 and 6+7 = 13 Which materials might these be ? Sticks, corn and bean seeds, paper squares, and buttons, among other items, may be used by the learner in sequence to show a set of seven and a set of six and by joining the two sets together obtain a set of thirteen markers The commutative property may also be shown by a learner. Changing is involved in that the pupil used diverse materials to show the value of two addends. Multiple discrimination, in the Gagne' hierarchy of objectives stresses pupils noticing 'differences and likenesses in ongoing lessons and units of study Analysis is involved here in that pupils separate the relevant from the irrelevant such as in seeking solutions to story or word problems. To do so indicated the need to make separations from what is needed to what is unnecessary. I believe the last three terms used by Gagne' are very significant in planning the mathematics curriculum Thus concept learning is very relevant. It takes a variety of learning opportunities using different materials of instruction for pupils to understand concepts such as addition, subtraction, multiplication, division, inverse operation, radius, radius squared, radius cubed, and exponents Understanding concepts are needed on the pupil's part in order that sequential achievement is possible in mathematics

Gagne's principle or rule learning indicates that learners relate concepts so they become usable A rule or principle such as "to find the area of a circle, square the radius and multiply by the value of pi" is necessary in a specific situation, otherwise pupils could not ascertain the area of a circle The last idea in Gagne's hierarchy is problem solving Thus principles or rules are needed to understand how to solve the problem of determining the area of a square, triangle or parallelogram

A strong point in Gagne's hierarchy of objectives is that the teacher needs to go back a step or level if a pupil does not understand what is to be done For example, if a pupil cannot solve a problem, perhaps he/she does not attach meaning to the involved rule or principle. If the rule or principle is a stumbling block to the pupil's progress, he/she may need to go back to learning the meaning of the inherent concepts within the rule or principle

Jerome Bruner and the Structure of Knowledge in Mathematics

Jerome Bruner, professor from the Harvard University, advocated a structure of knowledge approach in teaching mathematics. The structural ideas in mathematics would be identified by professional mathematicians in their academic area of speciality These professional mathematicians then choose key or main ideas for pupil attainment The structural ideas may be used again and again by the learners as they proceed to more complex learnings on sequential grade levels. In mathematics then pupils may attain the following in increased levels of complexity

1 Commutative and associative properties of addition and multiplication
2 Distributive property of multiplication over addition
3 Property of closure
4 Subtraction as the inverse operation of addition
5. Division as the inverse operation of multiplication

The above examples of structural ideas can be emphasized on sequential grade levels at increasing levels of complexity For example first grade pupils may learn that 4+3 = 7 and 3+4 = 7; this stresses the commutative property of addition. At a higher grade level, fifth grade pupils may learn meaningfully that 18 996 + 38.649 = 38 469 + 18.996.

Jerome Bruner stressed the use of three kinds of materials in teaching mathematics to pupils. In sequence, these would be enactive, iconic, and symbolic Enactive materials emphasize the use of concrete materials and other objects for learner manipulation in a hands-on-approach in learning Second, pupils learns through the use of iconic materials which include pictures, illustrations, video tapes, video discs, slides, filmstrips, and other audio-visual aids Third, Bruner stresses the use of symbolic materials, such as printed content in textbook, library books, and other abstract content This sequence in pupil learning then emphasizes the teacher using concrete, semiconcrete, and abstract materials in teaching

Jerome Bruner advocates the use of inductive methods of instruction in which pupils discover structural or major academic ideas of a discipline To emphasize Bruner's approach in teaching, the teacher should attend to the following :

1 The teacher needs to have an excellent knowledge of the structure of knowledge since these key ideas become objectives for learner attainment.

2 To achieve objectives on the pupils' part, the teacher needs to sequence learning opportunities in that individuals experience the enactive, the iconic, and the symbolic in that order

3. The teacher must appraise pupils to ascertain how many of structural knowledge objectives are being attained by pupils in a spiral curriculum With a spiral curriculum, pupils meet up again in increasing levels of complexity the structural ideas which serve as objectives of instruction

4 The teacher needs to become a quality asker of questions involving the ongoing mathematics lesson so that pupils can truly learn in an inductive manner Inductive teaching then assists pupils to achieve the structural ideas.

5 Inductive teaching in mathematics must be used together with the enactive, iconic, and symbolic materials of instruction

Jean Piaget and Development Psychology in Mathematics

Jean Piaget studied pupils in clinical settings for over forty years in Switzerland. He identified different stages that pupils go through in the maturation process. The first stage called the Sensorimotor Stage occurs from birth to two years in the infant's life. Here, parents need to have objects for the young child to manipulate and experience in a friendly environment. The child then experiences and perceives objects such as toys in the real environment. He/she may touch, smell and see the objects Listening to sounds made by these objects is also salient in sensorimotor learning.

The preoperational stage of development of the child roughly occurs from ages two to seven years Here, the young child perceives one variable largely. Thus the preoperational child when viewing two tumblers of the same brand name and size as having an equal amount of water in each, if this is the case. Now, in front of the child, one of the two tumblers of water is poured into a taller, thinner tumbler. The child is asked which has more water inside the tumbler The preoperational pupil will answer the taller thinner tumbler does. The child perceives one variable in that one tumbler is taller than the other and therefore contains more water If two spheres of clay are held in front of the preoperational child and both are identical in amount, the child will say neither has more clay in it than the other But, if the experimenter flattens one sphere in front of the child, he/she will say that the flattened clay has more in it than does the sphere of clay. Again, the preoperational child perceives one variable only and that being the flattened piece of clay is longer than the spherical lump of clay Teachers of kindergarten and first grade pupils need to be aware that preoperational pupils lack maturation to notice that there is more than one variable to objects being observed Preoperational pupils are perceptionally oriented How something looks to the child is the correct perception or view They tend to centre on one variable such as the larger the area that one of two sets of marbles is placed in, even though both sets have an equal number of marbles, the larger the number of marbles of that set in the enlarged area. Thus if a set of six marbles is placed in a larger area, it will have more marbles than a set of six placed in a smaller region

From ages seven through eleven, Piaget, in his research, found that these learners still needed concrete objects to learn from. Piaget called this the stage of concrete operations. Here, the learner has matured to emphasize reversibility Thus the pupil may notice that the order of addends can be changed and yet the sum stays the same Or the concrete operations pupil learns that there are number families such as 7+5 = 12 and 5+7 = 12, which can be undone through subtraction within that number family such as 12-5=7 and 12-7=5 Reversibility also indicates that one can go back to an earlier stage of working on a project or activity and come back to the original starting point One may go back (reversibility) to an earlier stage in unit teaching to further analyse what was done One can also reverse to the original stage prior to emphasizing reversibility Thus the concrete operations development pupils may perceive several variables when reversibility is in evidence

Additive composition is also a part of the learner's stage of concrete operations. With additive composition, the pupil in perceiving numerous variables, may define, for example, what the identity elements are for addition and multiplication. There are numerous descriptions which can be given in the definition indicating again the pupil's ability to focus on several items at one time. All the definitions possible add up to a sum pertaining to the identify elements for addition and multiplication

The principle of associativity is also a part of the concept the stage of concrete operations. With associativity, the pupil can add three or more numbers in any order. Or three or more factors may be multiplied in any order and the product is the same. Many tasks may also be taken up in any order and the results are the same or similar In all facets of the pupil being in the stage of concrete operations, the teacher still needs to refer to and use concrete materials along with the abstract being emphasized

At about twelve years of age, pupils enter the stage of formal operations. At the stage of formal operations, learners might be able to think abstractly in mathematics without reference to concrete materials of instruction. Learners in all stages of development need to operate or focus on what is being learned for learning to really take place

There are numerous implications for teaching mathematics when using Piaget's research in teaching learning situations. These include the following

1 The teacher must study the maturational levels of pupils in order to know what and how to teach these learners.
2 There can be much wasting to time in teaching what the maturational level of the involved pupil is not ready for Then too, the teacher must teach what the maturational level of the pupil is ready for in mathematics. Otherwise time slips by without the learner attaining as much as possible
3 Hastening the readiness of a pupil for learning mathematics does not work The maturational level will indicate what can/cannot be taught.
4 There needs to be an adequate amount of concrete materials available for teaching since through the age of eleven, the stage of concrete operations is still in the offing.
5 Securing attention for learning is salient since learners do not achieve unless they mentally operate upon the content being presented.

According to Piaget and Imhelder (1969), there are definite factors that impinge upon pupils as they progress in intellectual development. These are biological maturation· interaction with experiences in the natural environment: social activities; and homeostasis, a balance between the self and experiences in the physical environment

Biological maturation stresses pupils going through the stages of sensorimotor, preoperational, concrete operations, and formal thought. However, there are factors that influence these stages of biological maturation. One factor is pupils interacting with the natural environment The richness of experiences here has much to do with learners developing biologically Thus a stimulating environment in mathematics definitely affects progression in biological development. Working with others or being in groups that stress collegiality and its influence on both biological and the affects of the natural environment. Certainly, pupils learn much from each other pertaining to the world of mathematics. In supervising student teachers and cooperating teachers. I notice how pupils might affect each other very positively in ongoing lessons and units in mathematics For example, in one class it was difficult for a pupil to understand and attach meaning to why the divisor is inverted and multiplication is stressed in the division of fractions. When this pupils and three others worked together in cooperative learning, one pupil made it very clear as to why the divisor is inverted and then multiplication occurs in the division of fractions.

Homeostasis emphasizes feelings of satisfaction that a solution has been found to a problem. Thus there is balance between the individual and his/her environment Equilibration has then occurred. In the previous example, when a learner understood what is involved when fractions are divided with the 'invert the divisor and multiply' rule, the pupil also has reached a state of homeostasis at that point Homeostasis may be followed again by a desire to know a new fact, concept, and or generalization. A good teacher will guide pupils to reach a state of disequilibrium so that an inward desire to learn is involved to seek new information and subject matter

Piaget emphasizes that what is learned is grouped together in schemes. These schemes provide key ideas upon which future learning of the pupil is based. Schemes are also called structural ideas. Structural ideas or schemes are patterns of behaviour of the individual. The pupil who has been actively involved in learning that 6+4 = 10, may now use these learnings to achieve the new to be stressed such as 6+5 = .and 5+6 =.....New content might then fit into the older pre-existing structures. In other words, previous content acquired in mathematics now sets the stage to learn more of higher decade addition. The involved process is called assimilation. There has to be accommodation so that the old and the new content might be blended

Piaget (1971) continually emphasizes active involvement of the learner in the mathematics curriculum when writing the following

If we desire to form individuals capable of inventive thought and of helping the society of tomorrow to achieve progress, then it is clear that an education which is an active discovery of reality is superior to one that consists merely in providing the young with readymade wills to will with and readymade truths to know with.

John Dewey and Problem Solving in Utilitarian Situations

John Dewey (1859-1952) advocated a utilitarian mathematics curriculum in which school and society would be related. Thus what is useful in society should provide the basis for the school curriculum. Thus in mathematics, pupils with teacher assistance identify a problem area. The problem is significant to the learner. He/she feels a definite need to find needed solutions. The problem then must be adequately delimited so that an answer can be found. Data or information is acquired in answer to the identified problem. The answer is tentative and subject to change due to further testing of the results. John Dewey did not consider textbook problems as being life-like and reality based. Predetermined questions raised by the teacher and objectives written prior to instruction for pupils to attain do not stress problem solving. Rather within context in an ongoing unit of study preferably, the learner or a committee of pupils choose a problem in mathematics which is vital to solve. This is a practical problem to solve which emphasizes being useful and stresses application of content/skills acquired

Problem solving then emphasizes the useful and the utilitarian in the pupil's life in the school setting. Mathematics is a curriculum area that can truly emphasize that which is functional. Thus situations such as the following may stress a practical mathematics curriculum with problem solving involved

1. Measuring ingredients for a representative food dish of a foreign nation being studied in social studies
2. Planning and preparing a holiday meal in school whereby each pupil brings a certain amount of a food item
3. Averaging scores of the number of words spelled correctly by a pupil

from six sequential weeks of spelling test scores

4. Developing a line graph from pupils individual birth dates in a calendar year.
5. Operating a simulated supermarket in the classroom using real or toy money.

The above are merely suggestions for a reality based mathematics curriculum. One needs to remember that John Dewey advocated that problems come from pupils and not from an extrinsic source The teacher guides the learners in selecting and solving problems. John Dewey believed that pupils liked to work on committees rather than individually in solving problems Learners, too, desired to find out on their own instead of being told how to locate an answer Pupils were to be active, not passive recipients of knowledge Creative behaviour is preferred much more so as compared to conformity endeavours

In summarizing John Dewey's problem solving approach in teaching pupils, the following are salient points :

1. Activity centered approaches are emphasized in teaching in that pupils are the focal point of the curriculum.
2. Mathematics stresses that pupils with teacher guidance select relevant lifelike problems which need solving
3. A learning by doing, not passivity on the part of pupils, is a must for learning to accrue in mathematics
4. Purpose and interest on the learner's part make for learner effort and perserverance in solving problems
5. The role of the teacher is to encourage, help, and assist pupils in attaining solutions to problems

In Summary

There are numerous psychologists who may provide teachers with guidance in teaching mathematics B.F. Skinner advocated a highly structured curriculum in which pupils would make few errors when achieving objectives arranged in an ascending order of difficulty. The programmer arranges the frames of learning in mathematics by using a sequence of read, view an illustration, respond, and check order. A psychology of behaviourism is emphasized here Responses are either correct or incorrect as given by pupils individually.

James Popham believes in using measurement driven instruction (MDI) with the objectives stated behaviourally. The stated objectives leave no leeway for interpretation The mathematics teacher then provides learning opportunities which contain only that which is in the stated objective Appraisal is done in terms of the stated objective to determine if learners individually have been successful achievers.

Robert Gagne' emphasizes a hierarchical arrangement of teacher written objectives whereby the learner attains each in ascending order of complexity. Should an objective in mathematics be too difficult to achieve, the teacher needs to assist pupils individually to go back to a previous goal so that background information may have been attained. Then, the pupil should be ready sequentially to achieve the original objective. I will review the last three objectives Gagne' stressed in curriculum development These are in sequence· concept development, attaining generalizations, and solving a problem, by the learner The mathematics teacher writes the objectives for pupil achievement. Dr Gagne', a former mathematics teacher, found that the teacher needed to go back to an earlier level of achievement if a pupil could not attain the preset objective being stressed in the curriculum Thus if a learner did not understanding how to solve a mathematics problem, he/she might need to go back to studying the related generalization that is inherent in the problem Should the learner not understand the generalization, he/she may need to study the related concept(s). Once the concept(s) are understood, the pupil is ready to be taught the related generalization. If the generalization is meaningful, the involved pupil might then be ready to solve the problem. Robert Gagne' emphasized going back to an earlier level of achievement if the pupil did not attach meaning to what is presently being taught Sequence in learning mathematics is very important to Robert Gagne'. All good teachers of mathematics prize highly if content, skills, and attitudes are learned sequentially by learners This may mean reversing to an earlier level of attainment if a pupil does not understand or comprehend that which is being taught presently. The sequence may also pertain to a learner being taught more complex subject matter in mathematics if presently the objectives have been achieved.

Robert Gagne' advocated a hierarchy of objectives for pupils to attain in mathematics which meet the following standards :

1. The objectives are arranged so that each pupil may attain an appropriately ordered set of goals which move from the easier to those increasingly more complex
2. The teacher may place another objective between two others if a pupil makes an error at that point.
3. The problems to be solved tend to be more abstract than those advocated by John Dewey
4. The objectives are determined prior to instruction.
5. Quality sequence in mathematics makes for fewer learner errors when being engaged in a lesson or unit of study The teacher sequences or orders the objectives for learner attainment.

Jerome Bruner emphasized that pupils on any grade level attain structural ideas in mathematics Mathematicians at the university level select and agree upon these ideas The structural ideas are available to teachers who teach pupils. Inductively, pupils are to achieve these structural ideas on an increasingly difficult level as they progress through sequential levels of attainment

Jean Piaget stressed the importance of pupils going through specific maturational levels such as the sensorimotor, preoperational, concrete, and abstract levels Biological maturation is salient when teachers ascertain what should be taught to pupils. The stage of concrete operations, for example, has associativity as one of its subcategories The associative properties of addition and multiplication, using concrete materials, should be taught at this stage (ages seven to eleven) of learner development.

John Dewey advocated a problem solving approach in which pupils identify and solve problems. The problems are lifelike and practical The useful and the utilitarian are emphasized Dewey placed strong emphasis upon democracy as a way of life Democracy then is more than a political system or a way of governing individuals. Democracy is a way of associating with others and a means of communication. It is a means of involving all who will be affected by a given decision (Dewey, 1916) Democratic means are needed to identify and solve problems. These problems need to be reality based and practical in the societal arenas Pupils then need guidance to select and solve life-like problems in mathematics To stress democracy in the school and classroom settings, learners should work cooperatively in problem solving endeavors in mathematics.

The teacher of mathematics needs to use a psychology of teaching which will guide the learner to achieve as optimally as possible. There are diverse psychologies available to provide guidance in helping pupils achieve, grow, and learn in mathematics. Pupils need to be able to use what has been acquired Meaning is then attached to facts, concepts, and generalizations achieved in mathematics The National Council of Teachers of Mathematics in 1989 developed excellent criteria, goals, and objectives for pupils to achieve. These are listed in their book Curriculum and Evaluation Standards for School Mathematics. The psychologies discussed above may well be used to guide pupils in goal attainment from those listed in Curriculum and Evaluation Standards for School Mathematics

REFERENCES

1 Dewey, John (1916) *Democracy and Education*, New York The Macmillan Company.

2. Gagne', Robert, (1984, 96-102 84) The Conditions of Learning New York ' Holt Rinehart and Winston.

3 Morris, Van Cleve (1976), *Philosophy and the American School Boston* Houghton Mifflin Company, 340

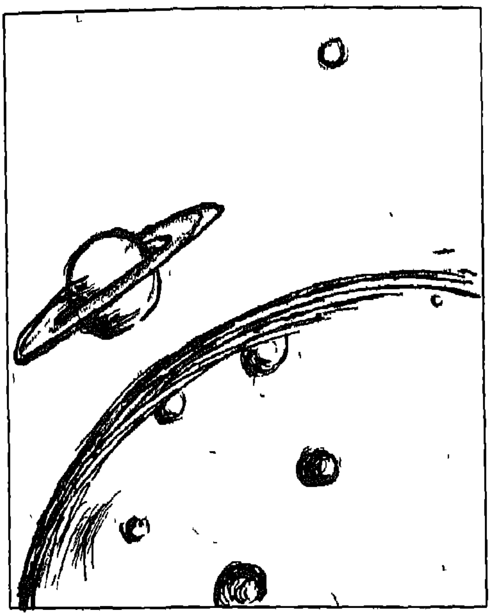
4 Piaget, Jean (1971) *Science of Education and the Psychology of the Child* New York Viking Press, 26

5 Popham, James (1970) *Alternative Avenues to Educational Accountability, Appropriate Practice; Educational Objectives, Establishing Performance Levels, Modern Measurement Methods; Opening classroom structures, Selecting appropriate Objectives, and Teaching Units and Lessons Plans* (These are filmstrips and related tapes on behaviourism as it applies to teaching and learning)

6. Shankaranarayana, B L (1990) *Achievement in Mathematics Under Guidance Discovery Learning and Reception Learning Conditions* Ph D thesis, Mysore, India. University of Mysore, 6,7

Modern Flying Carpet : The Helicopter

K.V. GOPALAKRISHNAN
Department of Mechanical Engineering
IIT, Chennai



The flying Carpet in the Arabian fable was supposed to be able to fly in any direction, forward, backward, upward, downward etc. and to land or take off from almost anywhere. In the modern world we have some thing which comes very close to the flying carpet - the helicopter. It can hover over a spot and rescue men trapped in steep cliffs or sinking ships. It can fly in all directions It can land or take off from the top of a building or a forest clearing (a fixed wing aeroplane requires at least a kilometre of concrete runway!) It is invaluable in calamities like floods, helping to evacuate people or rush supplies. The armed forces also put it to a great variety of uses

The concept of the helicopter is several centuries old but it came into general use later than the aeroplane. The reason was the technical difficulties faced in translating the idea into practice

The earliest recorded concept of the helicopter occurs in the notebooks of the great painter and all round genius, Leonardo da Vinci (1452-1519) Several subsequent inventors built and tried out a number of models powered by rubber bands, steam etc. But only with the invention of the petrol-driven internal combustion engine did man-carrying helicopters became feasible. Paul Cornu (1881-1944) is credited with being the first to carry out a manned helicopter flight in 1907 But controlling a helicopter in flight is far more difficult than controlling a fixed wing plane and required a lot of development before it could be generally used

The father of the modern helicopter is Igor Sikorsky (1885-1972). He was born in Russia. As a young boy, he once saw Leonardo da Vinci's sketches of the helicopter — and was hooked for life to the subject. His early attempts as a boy and young man to build helicopters were not successful and he reluctantly turned to the design of fixed wing planes. He became quite a successful aircraft designer He emigrated to the U.S A. on the outbreak of the Russian Revolution in 1917 and achieved success there too in designing airplanes But his heart was really set on developing helicopters. In 1938, with limited support from the firm United Aircraft, he once again started work on helicopters and in two years succeeded in demonstrating the amazing ability of the craft to hover over a spot and take off and land vertically on unpaved land But the inherent difficulties in controlling its flight delayed its general use until after the Second World War In the Korean war of 1950-1953, the helicopter at last demonstrated its utility and great versatility. Wounded troops were quickly evacuated from difficult terrain like mountains and valleys, supplies and reinforcements were rushed to critical spots and many other valuable functions were performed by this "Workhorse of the Sky" Thereafter, the development of the helicopter has been rapid

Today we have a variety of helicopters. Some are designed as "flying cranes" that can lift a heavy lorry into the sky Some can carry 30 or more armed soldiers. Some are used to lay electric power lines in mountains and forests Other uses include traffic observation and direction by the police, crop spraying, fighting forest fires, geological surveying and even herding cattle! The armed forces also have myriad uses for the helicopter In human terms, it is most valuable during natural disasters and rescue operations. In one incredible instance, a man being dragged swiftly by the river current towards the Niagara Falls was plucked out of the water by a helicopter!

The heart of the helicopter is its rotor system. The power required is supplied by reciprocating internal combustion engines or gas turbines The lift for the helicopter is provided by the main rotor, rotating about a vertical axis (see Fig 1 1). To prevent the helicopter structure from rotating in the opposite direction as a reaction, a tail rotor is used to provide the counter thrust In some cases, another rotor mounted on the same shaft as the main rotor and revolving in the opposite direction is used for this purpose Yet another variation is to have two separate vertical axis rotors revolving in opposite directions (Tandem Rotors) To fly forward, backward or sideways, the pilot tilts the rotor in the desired direction The speed of the helicopter is controlled by changing the pitch (that is the twist) of the main rotor blades By changing the pitch of the tail rotor blade, the helicopter can be made to turn about itself in flight But managing a helicopter while hovering or low speed flight is quite difficult and requires high skill and experience on the part of the pilot. Modern helicopters are capable of forward speeds upto 350 km/hr.

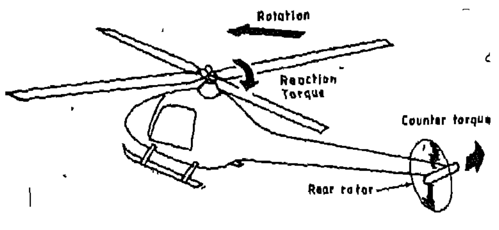


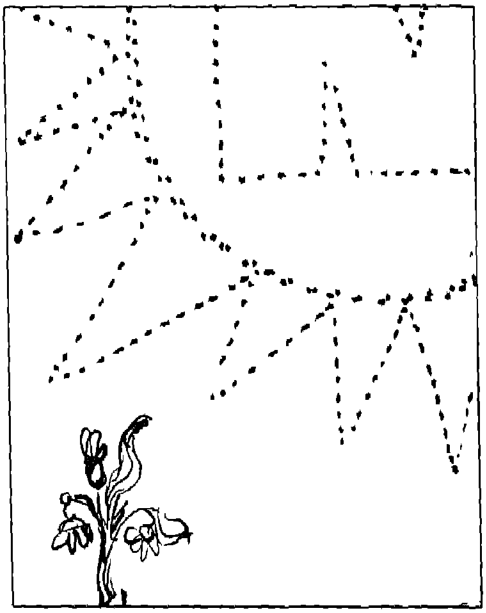
FIG.1.1 **Basic Components of a Helicopter**

Some hybrid models have also been built, with small fixed wings, along with propellers or jets for taking care of the forward motion of the helicopter. Yet another model employs rotors which rotate in the horizontal plane during take off and then tilt 90° to function as propellers, along with fixed wings The possibilities seem endless and helicopters are bound to play an increasing role in many applications in the future

Behind the success of the helicopter lies the decades' long effort of its inventors, in many cases doggedly carried out in the face of the widespread scepticism and scorn of their peers Their spirit is summed up in a saying that one of these great pioneers, Igor Sikorsky, prominently displayed in his office' "According to the recognized laws of aerodynamics, the bumble bee can not fly because the shape and area of its wing in relation to its body is not right But the bumble bee does not know this, and so he goes ahead and files anyway"

Nuclear Technology and Public Health

I O Essien
Department of Chemistry and Biochemistry
University of UYO, P.M.B. 1017,UYO
Akwa Ibom State
Nigeria



The words "nuclear technology" register in many people's mind an atomic or a nuclear bomb, hence nothing more than destruction. This impression is not always correct since nuclear technology is also used for peaceful purposes. Isotopes of some elements emit radiation as their nuclear decay and they are called radioactive isotopes, radioisotopes or radionuclides. Some of these radionuclides occur naturally while others are artificial and the study of these radionuclides is called nuclear science. Nuclear technology is therefore the various nuclear techniques developed from nuclear science which make use of mainly radioisotopes or radiation procedures in response to the challenges imposed by the nuclear age. Their range of application is extremely broad, which may be both constructive and destructive.

The application of these nuclear techniques will therefore have some advantages and disadvantages on public health, since these radionuclides will be used in the environment. The inhibitants of the environment, such as man, animals and plants may benefit from the detrimental effects of the nuclear accidents and radiations.

Advantages of Nuclear Technology

The socio-economic development of many great nations have been achieved through the help of nuclear technology. Some of the areas in which nuclear technology has been applied are, power generation, medicine, industry, agriculture, research and environmental management.

The generation of electricity from nuclear power plants have now been practised in many countries of the world. This source of energy has been recognised as an economic and a clean source of energy as compared to the other sources of energy. According to Atseyinlu (1992), the nuclear energy is a viable energy source, and is beneficial in many respects, but it involves great risks and environmental problems

The determination of metabolic pathways, visualization of organs, localization of tumors, detection of abnormalities in diagnosis, use of radiation sources for therapy, sterilization of medical instruments are some of the major goals of nuclear medicine. Nuclear medical equipment, including scintillation gamma chambers, high energy gamma (HEG) scanner, and two channel profile scanners have been manufactured and are being used for detection of internal diseases Wide use is made of radioisotope tracer techniques in this area, such as in the preparation of radiopharmaceuticals for clinical diagnosis of various abnormalities In Nigeria, for example, where there are no definite nuclear programmes, some form of secondary applications of nuclear techniques in medicine have been done, These are found in areas of diagnosis of diseases prevalent in developing countries such as tuberculosis, viral hepatitis and malaria.

Nuclear techniques are used in the industry in various ways. Some of these include, the measure and control of fluid flow, wear and tear of engine parts, production of concrete polymer materials, optical glass colouring, plaster composition, hardening in large size electro technical products Thermo-settling pipes, bands and other insulating and construction products have been produced with polyethylene which are treated with accelerated atomic particles Radioisotope methods and equipment have been used in production of a non-stop analysis of the composition of substances for determining ash content of brown coal and coke and for measuring the depth of charge in blast furnaces Radiation technologies have been used for leather conservation, rubber vulcanization, textile fabrics, hardening of paints and varnishes, timber and abrasive materials, and in disinfestation and conservation of works of art In the beer industry, isotopic techniques are used in detecting the levels of beer in the bottles

In agriculture, there are various uses of radioisotope tracers to monitor plant growth, development and plant diseases. Radiation sources have been used to solve some agricultural problems — some of which include the elimination of insect pests by mass release of insects made sterile by irradiation, the radiation disinfestation of grain, and the use of radiation to produce useful plant mutations. Nuclear techniques have been employed to preserve food and agricultural products Radioisotopes have also been used as tracers in many research studies. In studies involving the rates of chemical reactions, structural determination, mechanism of reactions and some physicochemical properties of substances, radioisotopes and nuclear radiations are widely used.

Nuclear techniques are increasingly gaining grounds in environmental management The use of isotopes and the development of analytical tools, including tracer methods, neutron activation analysis (NAA), X-ray fluoresence and atomic absorption spectrometry have added to the techniques available for the study and detection of environmental pollutants such as pesticides and toxic metals. The use of nuclear technique in ground water pollution research is an example of the value of nuclear techniques in water pollution studies. Sewage water purification is now done with radiation technologies and isotope techniques have greatly assisted in the studies of our ecosystem

Health and Environmental Risks

Health and environmental risks are very vital issues when dealing with nuclear energy. Generation of nuclear energy as well as use of radioisotopes in research, medicine, agriculture, and industry produce radioactive wastes which add to the naturally occuring radioactive substances found in our environment This addition of artificial radioactive substances causes concern, since they are more concentrated and contain substances of high level activity as well as substances of lower level activity but with very long life time Studies show that the soil samples of Hiroshima bomb incident contains high levels of radioactivity up to date, (Sakanoue and Tsieji, 1971). If these substances are not properly handled, they can contaminate the environment and present serious health hazards to man, animals and plant lives. At present studies have shown that most of our earth's surface is contaminated by radioactive fallouts (Essien, 1991)

The release of radioactive materials and radiations are the subsequent results of nuclear energy and most of the instances radioactivity released into the environment come from the misuse of nuclear energy by man as in nuclear weapon manufacturer, testing and use, and from improper handling methods and disposal of the radioactive materials It is expected that careful handling, controlled and peaceful applications of nuclear technology will continue to have little or no serious adverse effect on the environment

Nuclear Accidents and Nuclear Waste Disposal

All forms of engineering technology and mechanical machinery have some type of accident risk to their operators, owners and to the public at large. Nuclear technology and installations are no exception There is always the great fear of nuclear radiation on the part of the public based on the memory of the effects of the nuclear weapons of the Second World War and the Nagasaki incident of 1945. Although the risk of a radioactive release accident is quite small, it is by no means negligible, and the fact that when one occurs, it can have horrifying consequences is what frightens people and generates opposition to development of nuclear energy (Aina, 1992). The SNAP - 9A incident and the recent Chernobyl nuclear disaster of 1986 have again showed that despite the elaborate safety measures in the nuclear industry, accidents could still occur. There is great need to constantly review the safety measures in the nuclear industry.

Management and disposal of radioactive waste is an important issue in the development of nuclear industry This problem is viewed by the public as being so serious, and hence the agitation for the closure of the nuclear industry. The debate on the issue is very understandable as the public is confronted with the fact that some nuclear wastes release radioactivity of almost instant mortal level if no protection is provided, and others maintain their radiotoxic character over a period which are many times exceeding the history of man It is worthy to mention here that the main objective of management and disposal of radioactive waste is control, containment and isolation from the biosphere so as to protect the environment and avoid health hazards According to Aina, (1992), scientists and engineers meeting under the auspices of International Atomic Energy Agency (IAEA) have for a number of years held that no additional breakthrough in technology is needed for the safe disposal of any radioactive waste, including high level such as spent fuel. Studies are continuing to further improve the already significant level of knowledge about long term behaviour of geologic repositories to facilitate selection of suitable locations

Environmental Effects of Nuclear Waste

The application of nuclear sciences in industry, medicine, agriculture, research, environmental management and power generation produce radioactive waste which release radioactivity into the environment. These wastes may contain very high level of activities as well as low level activities As discussed above, if the wastes are handled and disposed properly they pose negligible danger to the public but when improperly handled can lead to serious environmental hazards and loss of lives. The waste can lead to radioactive contamination of vegetable crops, vegetation, grazing animals, such as cows, sheep, horses, and goats making them unfit for consumption. They can also contaminate our surface soils, water bodies, making our crops, and marine foods also unfit for consumption. Groundwater may also be affected and the entire food chain connecting man to plant can be seriously affected Generally, the radioactivity released could also have serious adverse effect on health man, such as cancer and could even lead to fatalities depending on the dose received

The occurence of a nuclear accident is another way nuclear technology might pose a significant danger to the public. The recent experience of Chernobyl accident in the USSR in 1986, led to environmental radioactive contamination of a very wide area. High levels of radioactivity were recorded in the air around the neighbouring countries Apart from the fatalities in the immediate vicinity of the area, there were noticed contamination of food, water, milk and meat products, which were declared unfit for consumption.

It is worth to note here that any form of nuclear radiation, directly or indirectly produces ionization and chemical change in its passage through matter. Therefore, intense irradiation of surface tissues are known to cause loss of hair, and skinburns, blood producing cells in the spleen and bone marrow are particularly sensitive and there are high probability of contracting leukemia and cancer. Genetic mutation can be caused by radiation damage to the chromosomes and death can be caused by an acute overexposure to radiation. Since damage or destruction to a cell requires a direct hit by only a single particle of radiation it is wise to take precaution to avoid even the slightest exposure to any form of radiation from the nuclear waste

Radiation Protection and Safety

There are very useful benefits derived from nuclear technology and we will continue to have workers in the nuclear industries, hence there is the need to establish radiation protections standards The second international conference of radiology in 1928 established the International Commission on Radiation Protection (ICRP) to set the required standards of permissible exposure to radiation A summary of these standards are presented in the table below for two categories of individuals namely (i) Occupational and (ii) the Ordinary Public.

Organ/Body Tissue	Occupational Max. Permissible dose per year (msv)	Ordinary Public Max. Permissible dose per year (msv)
1. Gonads/Red bone marrow	50	7
2 Skin/Bone/Thyroid	300	30
3. Head/Forearms/Feet/Ankles	750	75
4. Other Single organs	150	15

In the S.I. Unit, the unit of radiation dose equivalent is the sievert (SV) which is defined as the dose in gray (GY) multiplies by the Quality Factor, (QF) Gray is defined as 1 joule per kilogram (1Kg) where 1Gy is equivalent to 100 rads. The rad is a quantitative measure of radiation energy absorption usually called the dose

The commission recommended the following to be observed

(i) The annual dose for occupational workers (those with routine exposure during their professional work) should not exceed 50mSv to the whole body.

(ii) Women of reproductive capacity should not receive more than 13 mSv on the abdomen for a quarter year.

(iii) Pregnant women should not receive more than 10mSv throughout a quarter

(iv) Radiation workers should avoid any unnecessary exposures.

We are all exposed to low level radiations every year Studies have shown that an average American receives an average dose of about 1 3 mSv/year (Foster and Wright Jr 1983)

Most of our low level radiations come from the following sources; cosmic radiations, ground radiation, internal sources, nuclear weapon testings, X-ray, medical checkups, wearing of luminous wristwatch, from watching coloured TV, nuclear power plants, etc. It is therefore very necessary that we stay away from any form of nuclear radiation as much as possible.

Conclusion

In conclusion, I seem to support the views of Awonaike (1992), who noted that there is no gain saying that application of nuclear technique would entail the consumption of radioactive food by the populace We should know that we are all radioactive. There is no place on earth or in the universe, where one can hide from radiation. We all have some form of radioactive radium and carbon in our muscles and radioactive noble gases and tritium in our lungs Studies have shown that radiation kills just as motor accidents and plane crash which are forms of engineering technology.

The potential benefits of nuclear technology for the development of our country can, therefore, not be overemphasised, provided the safety requirements for the peaceful use of the nuclear technology are strictly observed. It is also viewed that the successful introduction of this technology requires interdisciplinary collaboration between relevant scientist, various government regulatory and financial agencies and industries. The health of the public will not be affected when all the arms associated with the operation, handling and supervision of the nuclear industry are all in place as in other developed countries.

REFERENCES

1 Aina, E O (1992). Nuclear Technology and the Environment. In the proceedings of the symposium on the Application of Nuclear Technology for Socio-Economic Development of Nigeria, Sheda Science and Technology, Abuja

2 Arnikar, H J (1982). Essentials of Nuclear Chemistry, Wiley Eastern Ltd , New Delhi, India

3 Atseyinku, B A (1992). Nuclear Power Plants — Issues and Options for NEPA and Nigeria, In the proceedings of the symposium on the Application of Nuclear Technology for Socio-Economic Development of Nigeria, Sheda Science and Technology, Abuja.

4 Awonaike, K O. (1992) Application of Nuclear Techniques in Agricultural Production, In the proceedings of the symposium on the Application of Nuclear Technology for Socio-Economic Development of Nigeria, Sheda Science and Technology, Abuja

5 Essien, I.O (1992). Contamination of the Earth's Surface by Plutonium and Uranium Fallouts, *J Radioanal Nucl. Chem.* 147, 269-275

6 Foster, A.R. and Wright, Jr R L. (1983), Basic Nuclear Engineering, Allyn and Bacon Inc , Massachusetts, U.S.A.

7. Friedlander, G., Kennedy, J W , Macias E S and Miller, J M. (1981). Nuclear and Radiochemistry, John Wiley and Sons, New York

8 Lawrence, J H , Manowitz, B. and Loeb, B S. (1964) Radioisotopes and Radiation, Dover Publications Pric , New York.

9 Sakanowe, M and Tsuji, T. (1971) Pu content of Soil at Nagasaki, *Nature*, 234, 92

Environmental Awareness among Higher Secondary Students of Science and Non-Science Streams

G C BHATTACHARYA
Sr Lecturer
Faculty of Education
Kamachha Educational Complex
Banaras Hindu University, Varanasi 221 010 (U.P.)

Environmental problem has become a global issue and seeking attention of all sorts of people. They are becoming more and more cautious about depleting resources, deteriorating standard of life and living beings due to ever increasing and serious problems of pollution, poverty, illiteracy and unawareness, low sense of civic responsibilities and growing tendency of indifference and negligence etc., which by some or other way constraining to think over and be conscious, well in advance

Consciousness helps in bringing awareness, the act of having or showing realization, perception or knowledge (Good, 1973) is concerned with its intent and action components of emotional and cognitive aspects In other words, it is the state of consciousness which enables one to think freely in a number of ways to enhance the level of one's own intention to shape his attitude and feel his behavioural responsibility.

Awareness requires knowledge, but any knowledge devoid of action may hardly assure any enduring result. Action is initiated when the right kind of attitude and values are being inculcated among people, right from the very beginning and sense of responsibility is developed.

Education, as it has been observed, is a powerful instrument, strong enough to perform the task of awareness development among people, in terms of all such burning issues like that of environment, population and poverty problems in India Among all these three dominating and overwhelming issues, the environmental problem, perhaps, is the most significant one and seem to be a great challenge before the humanity and human beings. It is essential for the young school going as well as adult people, for their more active involvement towards the development of livable and comfortable better future through development of better appreciation and understanding of the consequences of unplanned human action and undesired activities upon the total bio-physio-psychological environment Whenever we talk about environment, we generally presume over-natural environment around us but, at the same time, it is concerned with psycho-social environment also. Environmental awareness, therefore, is the state of one's awareness towards the environment and concerned with the factual familiarity or knowledge as well as attitude and responsibility towards environment and various environmental issues Thus, environmental orientation or the degree of information, environmental attitude or the normal and neutral state of readiness to respond, organised through experience, exer~~ting a d~~irective or dynamic influence on behaviour (Allport, 1955) towards environment and the responsibility regarding environmental issues and duties, or the inner urge, external or internal compulsion to perform a given task, action and inclination to work consciously, are the three major dimensions of environmental awareness

The World Book Encyclopedia has defined environment as many factors which influence man and other living things, some of which are internal and inherited, others are external. A combination of these internal and external factors, makes up the environment Physical, Chemical, Biological and Cultural factors are in man's external environment.

The International Encyclopedia of Social Sciences defines environment as the aggregate of all the external conditions and influences, affecting the li and development of an organism

In the Dictionary of Education, Goo (1973) defines environment as a gener term designating all objects, factors an conditions that affect the individu through such stimuli as one is able t receive.

Therefore environmental awarenes is taken as a composite of factual familiarity (i e. knowledge pertaining to th environment) and personal variable (i e attitude and sense of responsibility towards environment), which represen one's conscious state of being toward own environment

The Fourth Five Year Plan (1969-74) in India marks the beginning of involvement of the government in environmental concern and for the first time, environmental consideration were articulated with the economic development Attention was also given towards the effective conservation and proper utilization of natural resources The National Committee of Environmental Planning and Co-ordination (NCEPC) started the implementation of its research programme through 'Man and Biosphere' and ' Environmental Research Committee' since 1972 Awareness and far sightedness within the government machinery have become explicit through the establishment of the Department of Environment on 1st November, 1980 and the preferences given to the environmental issues in Sixth Five Year Plan (1980-85).

In the field of education, Singh, M and Rao, L S.P. (1981), Gupta, U P., Grewal, J S and Rajput, J A (1981), Manual, N V. (1982), Deys, and Bhattacharya, G.C (1992), Singh M P et.al (1985) and many others initiated research investigations to know more about environmental problems and the state of awareness towards environment, pollution, potentialities etc , and invariably concluded that the environmental information and awareness are inevitable for protection of life and living things as well as sustenance of mankind on the globe of the earth, which are in tune of the findings of many a foreign research findings and views of naturalists and scientists

But even then, a general idea has been developed and observed among the uneducated mass of rural India as well as among some educated people too, that the students belong to the science stream and specialization at the higher secondary stage of school education may develop well a better understanding of environmental issues and awareness in comparison to their counterparts, in the non-science stream at the same level of education. This idea gave an impetus to know about the reality to the investigator through a research investigation, planned to conduct among higher secondary students of science and non-science students in Varanasi, for determining their environmental awareness

Objectives

The objectives of the study have been delineated as following —

To determine the ·

a) Difference between the higher secondary students of Varanasi belonging to the science and non-science streams, in terms of their environmental awareness,
   (i) difference between the higher secondary students of Varanasi belonging to the science and non-science streams, in terms of their environmental orientation
   (ii) difference between the higher secondary students of Varanasi belonging to the science and non-science streams, in terms of their environmental attitude
   (iii) difference between the higher secondary students of Varanasi belonging to the science and non-science streams, in terms of their environmental responsibility.

(b) Sex-difference between the higher secondary students of Varanasi belonging to the science and non-science streams, in terms of their environmental awareness

Hypotheses

Statistical hypotheses were framed in null form as following · Ho:X - There is no significant difference between the science and non-science streams of higher secondary students of Varanasi, in terms of their environmental awareness.

Ho· X - (a) Higher Secondary students of Varanasi belonging to the science and non-science streams, do not differ significantly, in terms of their environmental orientation.

(b) Higher Secondary students of Varanasi belonging to the science and non-science streams, do not differ significantly, in terms of their environmental attitude.

(c) Higher Secondary students of Varanasi belonging to the science and non-science streams, do not differ significantly, in terms of their environmental responsibility,

Ho · Y - There is no significant difference between the male and female higher secondary students of Varanasi belonging to the science and non-science streams, in terms of their environmental awareness.

Terms

(a) Environmental Awareness :It is one's conscious state of being towards his/her own environment and considered here as a composite of the factual familiarity and personal variables of attitude and responsibility

(b) Higher Secondary Students :The male and female-learners studying at the +2 stage of school education, either in higher secondary schools or Intermediate colleges in Varanasi and are concerned with science and non-science streams of education.

(c) Science Stream : All the courses either ~~related with physical or~~ biological sciences, ~~have been considere~~d to form the science stream

(d) Non-Science Stream : All the groups ~~of courses concerned with~~ humanities and social sciences, have been categorized as the non-science stream

~~*Delimitation* : The study was~~ confined to ~~the higher secondary or~~ +2 stage learners of school education and mainly the arts students were taken into account under non-science stream as commerce and other groups of students were not available in all institutions

The schools located within the city of Varanasi were contacted especially the English medium schools as they are generally having facilities and considered as better sources of Science education

Method

Normative survey design was used for investigation purpose All the male and female students at higher secondary level belonging to the Eastern U P were taken as the population of the study belong either to the Science or Non-Science streams of education

Sample

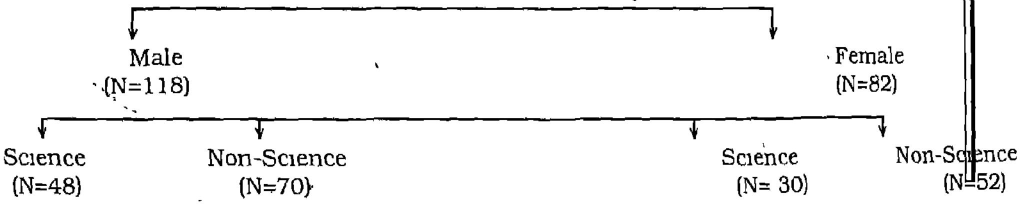
A representative sample of higher secondary students was selected for the study out of the defined population using random cluster sampling technique.

Initially, seven English medium schools in Varanasi were selected randomly out of the list of all such schools where provision of both the science and non-science education is existing. The students of Science and Non-Science subjects framed two separate clusters out of which 200 students were selected randomly, as given in Table 1 1

In this way, out of all 200 higher secondary students 118 were males and 82 were females as well as 78 were science and 112 were non-science stream learners.

TABLE 1 1

Break-up of the Sample
(N = 200)



Tools

To measure the environmental awareness of the selected higher secondary students, the measure of environmental awareness (M E A) developed by Singh and Rao (1981) was selected which is a quite appropriate, reliable and practicable tool for such investigation, constructed at Vikram, A Sarabhai Community Science Centre, Navrangpura, Ahmedabad This five point Likert type rating scale was administered to the students in groups of 10 to 15, after providing them with proper instructions and briefing, when Expert opinion and pre-tryout of the adopted form of the tool on a small known sample of 20 students for correction of the language, statement structure and item complexity etc , were done

Reliability and validity of the tool were ascertained on the line of original authors To establish reliability internal consistency of the tool was determined using split-half technique and superman—Brown Prophecy Formula (Tuckman, 1978) and the co-efficient of correlation was determined as high as 0 92 establishing a fairly good consistency of the tool.

Since the test items were carefully framed, keeping in view the several aspects of environmental issues and original three dimensions of orientation, attitude and responsibility and each item was critically evaluated by five experts in the field, the content validity of tool is high. The construct validity is obviously high due to high internal consistency

The main areas of the item are population, pollution, nature, health and nutrition, land usage, forestation and deforestation, like original form and out of 50 statements 22 were concerned with orientation, and 14 with attitude and responsibility dimensions each.

Scoring Weightage of 5 to 1 was given to the alternatives of strongly agree to strongly disagree in cases of favourable items whereas the reverse order of scoring was used in cases of negative items

Statistical Analysis

After obtaining summated scores of each respondent, parametric statistical measures of central tendency and difference between means were computed after tabulation and objective-wise analysis.

Results and Discussions

To verify the hypotheses framed, the results obtained have been presented through Table 1 2 given below

TABLE 1 2

Comparison of Science and Non-Science Stream Higher Secondary Students

S. No.	*Groups*	*N*	*Mean*	*S D.*	*'t'-value*	*Result*
1	Science	78	188	25 53	8 05	Sig at 01 level
2	Non-Science	122	162	31.31		

The above reveals that the obtained 't' - value is precisely high enough to be significant at 01 level of confidence which rejects the Ho · X stated as :

There is no significant difference between the science and non-science streams of higher secondary students of Varanasi, in terms of their environmental awareness.

Since the average score of the science stream higher secondary students of Varanasi is obtained higher than that of their non-science counterpart, it is obvious that the students belong to the science discipline are comparatively better in terms of their environmental awareness Thus, it may lead to conclude that the discipline may affect the environmental awareness of the learners through provision of better and specific knowledge and information If it is accepted, there may not perhaps be any harm to recommend science education for all atleast upto higher secondary stage of education which may broaden the horizon and views of the learners and bring them in a position to be able to function as more and more aware towards serious environmental issues. The selection of discipline and choice of optional streams may be initiated from graduation level of education

To verify the other dimension-wise hypotheses, the following comparisons were made and the results thus obtained were presented in Table 1 3 given below

TABLE 1.3

Comparison of Science and Non-Science Streams : Environmental Orientation

S No	Groups	N	Mean	S.D.	't'-value	Result
1	Science	78	83 51	12 67	9 53	Sig at 01 level
2	Non-Science	122	67 42	13 58		

N = 200

Table 1 3 reveals that the obtained 't'-value is significant at .01 level of confidence and thus the two groups differ from each other. Thus, the hypothesis Ho · X (a) stated as : 'Higher Secondary students of Varanasi belonging to the Science and Non-science stream, do not differ significantly, in terms of their environmental orientation', stands rejected

Here also, the average score of the science stream of higher secondary students of Varanasi is found higher than that of their non-science counterparts and therefore, it may be concluded that the knowledge aspect of these students are much sound and comparatively better. It may be due to the nature of science curriculum at this level which includes a number of topics concerned with environment and ecology, in general, and in case of biological science, in particular The science curriculum is strong enough to provide with the students about scientific knowledge regarding environment, pollution and its consequences upon life and living things and plays a significant role to enhance their standards of knowledge in comparison to the arts and other non-science group of learners, usually lagging behind them, in terms of environmental orientation.

Further, analysis of the data, concerned with environmental attitude was done and the results obtained depicted through to table given below

TABLE 1.4

Comparison of Science and Non-Science Streams . Environmental Attitude

S No	Groups	N	Mean	S.D.	't'-value	Result
1	Science	78	48 31	9 15	0.29	Sig.at .01 level
2	Non-Science	122	48 93	10.35		

N = 200

Table 1.4 reveals that the obtained 't'-value is not higher enough to be significant at any accept (either .05 or .01) level of confidence and thus, it may be said, that the two groups do not differ from each other Therefore, the hypothesis Ho X (b), stated as 'Higher secondary students of Varanasi belonging to the science and non-science streams, do not differ significantly, in terms of their environmental attitude', is accepted.

This indicates that the formation of attitude towards any issue or object may not depend upon the nature of discipline and the formal instructional situation as well as of curriculum structure It may be possible that the other agencies (non-formal like media, play-groups, social contacts etc.) play a better and significant role in attitude formation on account of which the environmental attitude scores of the non-science stream of higher secondary students of Varanasi was obtained to some extent higher than that of their science-group counterpart, though not as high as to make the difference significant at any level of confidence It helps one to recommend to enhance the responsibility of media and other agencies to develop better and positive attitude among people towards environmental issues, as early as possible

The comparison was made further between the two streams of higher secondary students, in terms of development of sense of responsibility towards environment, the third dimension of environmental awareness and the results have been presented in Table 1 5.

TABLE 1 5

Comparison of Science and Non-Science Streams : Environmental Responsibility

S. No	Groups	N	Mean	S.D	't'-value	Result
1	Science	78	55.89	9.81	9 21	Sig at .01 level
2	Non-Science	122	42 77	13.82		

N = 200

Table 1 5 reveals that the obtained 't'-value is as high as to be significant at 01 level of confidence and thus, it may be stated, that the two groups differ significantly from each other regarding their environmental responsibility Therefore, the hypothesis Ho.X. (c) stated as " 'Higher secondary students of Varanasi belonging to the Science and Non-science streams, do not differ significantly, in terms of their environmental responsibility stands rejected

This shows that the higher secondary students of Varanasi belonging to the science stream, possess a significantly better sense of their responsibility towards environment and it protection than that of their non-science counterpart

This may be the outcome of development of scientific reasoning and analytical approach to understand and solve any problem through scientific observation and drawing conclusion. They may develop power of application of their knowledge through scientific way of study which may not be possible for the non-science students due to theory-based approach of their subjects of study This indicates that to make one more and more responsible, it is necessary to be given more and more chance of active observation, participation and to follow the analytical approach.

To find out the sex difference among the higher secondary students of Science and Non-science streams, in terms of total environmental awareness scores, the results obtained were presented in Table 1 6 below :

TABLE 1.6

Comparison of Male and Female Higher Secondary Students of Science and Non-Science Streams

S No	Groups	N	Mean	S.D.	't'-value	Result
1	Male	118	162	33.67	6 85	Sig at
2	Female	82	169	22.75		.01 level

N = 200

Table 1.6 reveals that the obtained 't'-value is as high as to be significant at .01 level of confidence and thus, it may be stated that the two groups differ significantly from each other regarding their environmental awareness Therefore, the hypothesis Ho : Y stated as . 'There is no significant difference between the male and female higher secondary students of Varanasi belonging to the science and non-science streams, in terms of their environmental awareness', stands rejected.

This establishes the existence of sex difference in environmental awareness and ascertains the female groups of higher secondary students as better than their male counterpart. To know about stream-wise sex-difference the results obtained were further analysed as below

TABLE 1.7

Stream-wise Comparison of Male and Female Higher Secondary Science and Non-Science Students

Science Stream :

S.No.	Groups	N	Mean	S.D.	't'-value	Result
1	Male	48	178	28.15	4.75	Sig at
2	Female	30	199	18.98		01 level

N = 78

Non-Science Stream :

S No	Groups	N	Mean	S D.	't'-value	Result
1	Male	70	149	19 72	7 67	Sig at
2	Female	52	176	20 75		01 level

N = 122

Since, the stream-wise comparison tables also reveals that both the groups differ significantly, irrespective of the streams with the female higher secondary students of Varanasi always ahead in comparison to their male counterparts, in terms of environmental awareness, the rejection, of the above hypothesis is further justified

Female students, were found comparatively more aware towards environmental issues which supports the findings of Singh and Rao (1981) also. Since the females are more attached to the environment by nature and on account of their traditional duties and responsibilities of cleaning and maintenance of surroundings in a better and healthy way, they eventually may become able to raise their awareness level without any conscious efforts, in comparison to the male group of students. This may help us to conclude that if science education is provided to all female students, the output, in terms of development of environmental awareness be improved well consequently, which may not only be good for her own but for the whole family, in due course to time.

The male groups in comparison to them, do not bother much about such issues and are quite indifferent to environment explicit the fact that more efforts and application of some new pattern and ways of teaching are essentially needed for them so that their awareness level could be raised in no-time to bring them at par with their female counter-parts.

The study implies that the education of science subjects and girls students should be more emphasized along with implementation of environmental education through non-formal system media etc., besides provision of compulsory science education upto higher secondary stage of school education This will certainly help the present as well as the future generations to get rid of many environmental problems without making any extra and additional efforts and devising special plan and programmes for environmental education.

REFERENCES

1 Allport, G W. (1955). *Attitudes A Hand Book of Social Psychology*, C. Murchinan (Ed) . Clark Univ. Press,. Warchester, Massachusetts.

2 Dey, S and Bhattacharya, G C (1992) *A Study of Environment in Higher Secondary School Students*, Res Mono (Unpub.) Faculty of Education, B H U., Varanasi

3. Good, C V (1973,Ed) *Dictionary of Education*, McGraw Hill Book Com U S A.

4 Govt. of Rajasthan Publication (1990) *National Environment Awareness Campaign A Report*, Deptt of Environment, Jaipur.

5 Gupta V P Grewal, J.S and Rajput, J S (1981) Environment Awareness Among Children of Rural and Urban Schools and Non-Formal Education Centres, InA *Survey of Edl. Res* , (Pt III), Ed. by M B Buch (1978-83)

6 Manuel, N.V. (1982). Environmental Personalities in Education InA *Survey of Educational Research*, (Pt III) Ed by M B Buch (1978-83).

7. Saxena A B (1986). *Environmental Education*, National Psychological Corporation, Agra

8 Singh, M.M. and Rao, L.S.P (1981) *M E.A. , Handbook for the Measure of Environmental Awareness*, Vikram Sarabhai Community Science Centre, Navrangpura, Ahmedabad.

9 Singh, M P. Et.al (1993) *Social Forestry and Environment*, International Books and Periodicals Supply Service, Delhi.

10. Tuckman, B W. (1978) *Conducting Educational Research*, Norwast Bruce Jovanevich, New York

11 Walman, B B. (1973) (Ed). *Dictionary of Behavioural Sciences*, Von.Nostrand Reinholt Co., Canada.

†The Story of a Stone*

D.N WADIA

> *"God worketh slowly; and a thousand years*
> *He takes to lift his hands off. Layer on Layer*
> *He made the earth, fashioned it and hardened it*
> *Into the great bright useful thing it is:*
> *Its seas life-crowded and soul-hallowed lands*
> *He girdled with the girdle of the sun."*

Once I had a conference with a pebble, one of those very familiar objects, which one sees everywhere around Jhelum and thinks no more of, and which the very donkeys that carry them on their backs hold in contempt. Certain pursuits in which I have been engaged for some years past have created in him a sympathy with my inquiry, and, in response, he enlightened me on the story of his past He thus expressed himself -

"My history is long, and the tale that I have to tell of a long life of restless adventures is almost illimitable My antiquity is to be measured by periods too vast for your human comprehension, before which the most ancient records of man's history are but as events not even of yesterday but of the last hour. The Himalaya mountains and the seas that wash the Indian shores on the east and west, symbols of time and eternity to man, are, in comparison with the aeons of time that I have passed during my existence on this earth, mere evanescent phases that have come and gone without number Within my experience, I have witnessed the birth and passing away of many seas, continents and mountains, and these, your important land-marks of the world of today, are the latest comers in a long line of such

"When I was born, the world was in its infancy, and an altogether different world it was I cannot exactly recall in detail the geography of the country of my birth. This much, however, is quite certain, that much of the north of India and Punjab of today lay deep under the waters of an ocean, the northern shores of which lay far beyond the plateau of Central Asia Its southern shores defined a continent in the south, of which the Deccan is a small existing fragment. That graceful pendant, the island of Ceylon, of course did not exist then, it together with the Deccan, formed part of a continent that stretched far on the other side of the Equator, how far I cannot say — it may be, towards Madagascar on the west and Australia on the east. The one notable feature of this tract of land of which I have a distinct remembrance, (because, as you will learn presently, it was connected with my percentage), was that a high range of mountains ran across it from the site of the present Sahyadris (Western Ghats) to the north as far as the Pamirs. The Aravallis of today are a weathered and shrunk remnant of that lofty pile The chisel of time has cut deep into them and out of their dust and debris built many a rock-system of India. I hold within me much of its substance and so do many of my congeners in the long line of descent.

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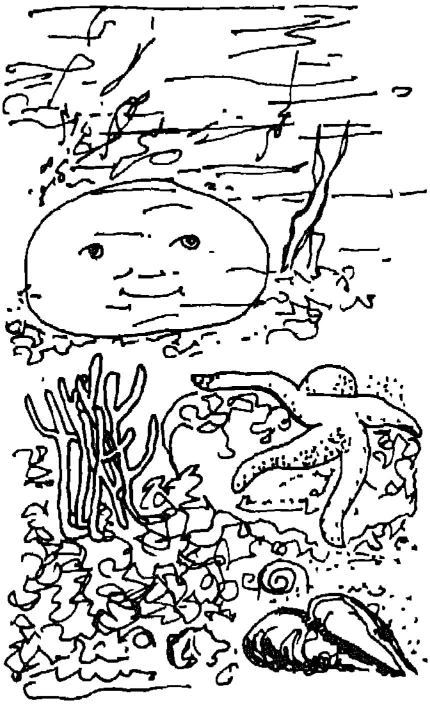
† Reprinted from the Prince of Wales College Magazine, Jammu and Kashmir, December, 1912

* Reprinted from 'School Science' No 1, Vol 2, March, 1963

"Such was the aspect of the physical world of my day. The world of living beings was stranger still, and far different from anything I have since beheld. It will want an effort of your imagination to realise the picture of that singularly desolate and barren world, from which all the varied and multitudinous races of animals which inhabit it today were absent. There were no quadrupeds, and no beasts of prey; no birds broke the silence of the air, nor any of the orders of the reptiles broke the gloom of the woods, no frogs, no fishes, even many of the humble invertebrates were absent from the silent deeps of the ocean They were yet to be born, their advent was but faintly heralded by the few insignificant, but universally spread, lowly class of coral-like animals and some crustacea and shell-fishes, which lived in the sea. The land was even more thinly peopled. The hill-slopes and plains were clothed with a sort of vegetation that has its modern representatives in the lower seaweeds, mosses and ferns. True some of these ferns and weeds did shoot their arrogant heads high in the air in the manner of trees of today, but it was a barren splendour only, for they were devoid of flower, fruit or seed such as you know them Living upon their scanty products were a few animals mostly of the insect and worm class.

"Now as to my birth, I have said that on the borders of the southern continent, i.e. the tract of country now occupied by the Himalayas lay the Sea. The bed of that sea was my birth-place The drainage of the land, gathered by a large river that flowed across it, was discharged, at its mouth into the sea Mingled in this water were loads of mud, sand and silt, as is the case with all running water on land Some geologists, curious in these matters have calculated the rate of waste of solid land by the agency of rivers and rain They have found that one such river, the Ganges, for instance, conveys 973,000 tons of such sediment daily to the Bay of Bengal. When you consider that not only the Ganges but other great Indian rivers, the Brahmaputra, the Indus, the Godavari, the Narmada, the Krishna — some of which carry even more silt than the Ganges — all assist in transporting the solid materials of the continent, you will realise that the waste of the hills and the plains is enormous, and will admit that, as the combined results of the action of all the rivers of the globe, the level of the earth is being reduced one foot in about every 6,000 years As is the case now, so it was in the past For in all inquiries of this kind you can take this as a cardinal principle (from us who have been the witness of nature's work since the earth's infancy). *The Present is the Key to the Past*

"There, deep under the mantle of the ocean, I lay, a sheet of white sand The successive floods of the river brought fresh loads of sand and these were laid down over those of the last season in a thin layer. Layer after such layer grew, as one tributary after another poured its freight of sediment It was while I was lying in this condition of loose, unconsolidated sand, on the sea bottom, that I first made my acquaintance with living beings of the period. They flitted about in the waters, or fixed themselves in the growing sands, or crawled over them Some of them were shell-fishes and starfishes, some crustaceans and sea-lilies, others corals and sponges, their uncouth and primitive forms, in contrast with the same animals of today, I yet dimly remember Their dead bodies, dropped upon the last layer of sand, would lie there till covered by the next deposit of sand brought by the next seasonal flood Then a curious process would intervene between the organic and the inorganic, and by a slow chemical molecular change, the organic body would be replaced particle by particle, by the inorganic substance of the sand, but

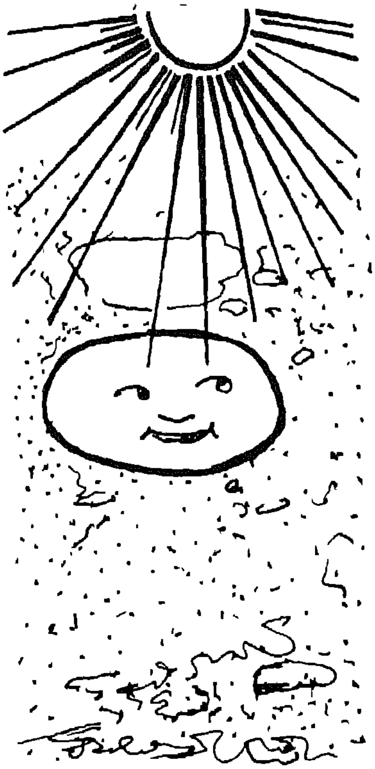


still preserving the details of its anatomical structure Eventually that relic of the dead animal would be converted into stone, to remain there for ever in its stony sepulchre, to bear witness to many an important fact and circumstance in long subsequent ages. Many such organic fragments, shells and skeletons were entombed in this manner in the bed of sand which was the parent mass from which I was derived. Some of us still bear such *petrified* remains, which you call *fossils* — chroniclers of the life and conditions of their times Well, the layers, or strata as you call them, continued to form one over another, each younger one resting on the next older, till in the course of long ages a thickness of some thousands of feet resulted. Under the pressure of this overlying mass, the lower (and older) beds were compacted and consolidated into a hard mass Infiltrating water carrying limy or silicious solutions introduced these substances into the sand beds; and they, acting as a kind a cement or matrix, converted the once loose sediments into a hard compact rock which you now recognise by the name of sandstone. Thus you see how I was formed out of the silt derived from the wasting of the land, no small part of which was contributed by the hill-slopes and valley-sides of the Aravallis. Up to now my days were happy Protected under the cover of waters, gathered with my parent mass, I was a stranger to the never-ending change and turmoil of the inorganic world My life of restless and infinite toil was yet to begin.

"Up to now the compacted and 'stratified' beds of sandstone were lying in their original horizontal position over the sea-bed. Then, by some far-reaching titanic process a slow upheaving of the earth began. The strata were compressed from the sides, twisted and folded—solid rock masses as we were—out of their original horizontal and level positions into curious unstable structures of arches and troughs. As a consequence of the upheaving movement, we began to merge out of the depths of the ocean waters, old Neptunes slowly retired from his old domain, and we were left high and dry. In a word the sea-bed was laid bare and converted into land, the new fabric being a piece added to the old southern continent

"Phenomena so wonderful as the uprise of the sea-bottom to form new land is difficult to conceive, and you are naturally astounded at the magnitude of the operations involved. But look around you and see whether the present geography of the world does not present some identical or parallel phenomena Here again apply the same principle of inquiry, observe the workings of Nature today, and you will find a clue to its operations in the past. Has not the coast of Sweden for many hundreds of miles lately risen out of the Gulf of Bothnia? The coast of Siberia, east of the Lena, for over 600 miles has risen out of the sea and is still rising. The eastern and southern borders of Japan are undergoing a slow elevation, witness the marks on its beaches, ask its fishermen and sea-captains. The same disturbance of the relative level of sea and land is felt along extensive tracts of Labrador, Newfoundland and Greenland But why quest so far? Have not similar things happened within historic times in India? Large areas, once famous historic sites, have been submerged under sea-water and converted into an inland sea, and other areas elevated beyond the reach of the waters to form mounds

"The coast of Kathiawar, the east coast of the Island of Bombay and the Konkan coast bear marks of recent alternations of the relative level of land and sea, and later still, though on a larger scale, are the changes in Assam and Chittagong But you must not imagine that these great geographical revolutions were accomplished in a few years or even centuries or that they were brought about by violent or spasmodic action. They were extremely gradual and protracted processes which took ages for their consummation A hundred generations of living beings roll away before their effect becomes perceptible Nature draws unlimited cheques on the Bank of Time



"Our time of trouble had begun. After the first flush of joy at our emerging into light and day we began to perceive our terribly exposed situation Rain and frost, wind and cold, the insolation of day and night and summer and winter, all these meteoric agencies began to tell upon the cohesion of the sandstone beds which composed the newly made land. Time, the great agent of ruin, lent its insidious aid to these forces. Percolating water, carrying with it dissolved gases from the air and acids from the ground, loosened and disengaged the constituent particles from one another and we soon saw every shower of rain that fell, after seasons of drought, carried away with it tons of sand and other disintegrated matter from us Cracks and crevices appeared, they widened into fissures and admitted more air and water— the two chief agents in rock-decomposition into deeper parts Another factor which helped in altering the surface was vegetation, which had taken hold on the ground and spread on it While at first it seemed to protect the surface from the atmospheric wear and tear of the ground, by means of its various organic acids and the oxygen and carbonic acid gas of the air which were introduced into the subsurface by the mechanically penetrating roots and rootlets it produced a layer of rotted rock mixed with the debris of the vegetation, — the soil. This growing soil-cap by supporting federation more actively only accelerated a further disintegration of the layers deeper and deeper. Meanwhile the rains of all these ages had worked a marvellous change on the originally smooth, uniformly sloping surface of the ground. The precipitated water in descending to lower levels cut tunnels; these, gathering strength, has formed into stream, which joined to form rivulets. By wearing out the softer parts more readily than the harder, and by eating into the sloping parts more actively than the level tracts, it brought about great inequalities in the originally uniform surface. In what was once a level plateau, hollows and ridges, mounds and depressions, hills and valleys were carved out by the energy of the running water as by the chisel of sculptor. Landslips were precipitated along slopes by the lubricating action of percolating water along crack-planes. Thus, the denudation, by the atmospheric agencies changed the face of the new land and gave to it the ordinary worn aspect which is such a feature of land scenery in all parts of the world. Of course all this went on as the normal routine of Nature, taking vast measures of time and just as naturally as you now see things going on around you.

"In one of these landslips I was thrown from a hill-side into the valley below. Thus detached from the parent home once and for ever, I lay in the fallen debris, a rough-hewn sharp-edged, massive block of sandstone, utterly unlike my present diminutive shape. Time rolled away. Torrential streams swept us along the river course. Each roaring debacle in rainy season carried us along with other blocks, knocking against one another and against the hard bed of the stream. Through new scenes and new lands we were rolled along and rubbed and scoured till even the hardest of us lost our original form and were reduced and rounded into boulders. Now stranded on some shingle bank, now dropped for a time on some sharp bend, now left high and dry for a long succession of rainless summers in the parched-up bed of the river, the ruthless transport continued. Eventually we reached the shores of the sea, — the great 'Tethys sea' of geologists, which stretched from the eastern extremity of the Himalayas to the north-west as far as the western limits of the Swiss Alps. There we were carried and dropped into its shallow waters, together with myriads of other boulders, pebbles, sand and other debris. Once more on the bed of the sea, we were cemented into the rock called conglomerate. Ages pass away, the great Tethys (as this ancient Himalayan sea is named) vanishes for a time and the rocks laid down on its bottom are uplifted and converted into dry land. Time and the weather again for their appointed task and after countless centuries we are once more set at liberty as loose stones and boulders, but only to be made again the sport of rivers and of the waves. Passing through these, we find ourselves once more on the beach of the Tethys which had returned to its former coasts after its temporary regression to the north. There, subject to the fury of the saves, hurled high in the air along their crests and rammed against the abutting cliffs, we worked our way once more beneath the water. Rounded by the constant rolling, reduced in size by the perpetual attrition, but otherwise unchanged, I yet held my own. But this ceaseless wear and tear had by this time ground into dust and sand most of my comrades Thanks to the crystalline structure and inherent hardness of my grain, this fate did not befall me

"Once more I became sealed up in a hard rock-bed A great depression of the bottom of the Tethys commenced and continued for long periods which carried us some thousands of feet below the surface of the earth A thick series of strata was deposited over the slowly sinking sea floor, and we lay in complete oblivion of everything in the deep plutonic regions of the earth's crust. Pressure and internal heat of the earth imparted to us a new grain and molecular structure What vast aeons of time succeeded since I thus lay deep in the bowels of the earth, and what the history of the earth may have been during these epochs, it is not possible for me to tell I can only say, ' that period was long enough for many widespread and striking changes to take place on the face of the globe—many lands with their highlands and mountains were denuded to their roots, many new rivers, valleys and lake-basins were formed, effaced and reformed, the coast-lines of all the countries were changed beyond recognition, in a word, the whole geography of the world was profoundly altered In the learned language of Science, this era during which I lay *perdu* is known as the Mesozoic era of the Earth's history and represents the passing away of three great divisions of geological time-the Triassic, the Jurassic and the Cretaceous The next succeeding era — the Cainozoic — was ushered in by a great reverse movement of upheaval of the sea floor, which put an end to the conditions of the Mesozoic times the Tethys was driven back by the steady uprise of its bottom and finally obliterated, leaving behind only the modern Caspian and the Mediterranean as its shrunken relics The strata were wrinkled and placated into earth-folds by the gigantic upthrusts which ensued. The forces of Pluto were gathered underground to produce the last and mightiest change on the face of our planet — the upheaval of the Himalayan chain of mountains on the site of what was once the bed of the Tethys Scarcely was this revolution complete and the forces of Nature were settling down to their equilibrium, when the claw of the weather dug me out of the rock-

bed, once again to play the part of a rolling stone and repeat my wanderings along the sea-beach or the river-bed. I will not tire your patience by detailing all my doings since then. Incessant and neverending change seemed to be my destiny. The rolling, rounding and attrition, in rivers and torrents of the new mountains, went on, fitfully and with long pauses, till at length I reached the edge of the Himalayas. A broad estuary was then covering the site of the present Siwalik foot-hills of the Punjab and among the deposits that were forming there (out of the debris of the newly risen Himalayas) I was dropped—my last station and present resting place—at the identical spot you discovered me in.

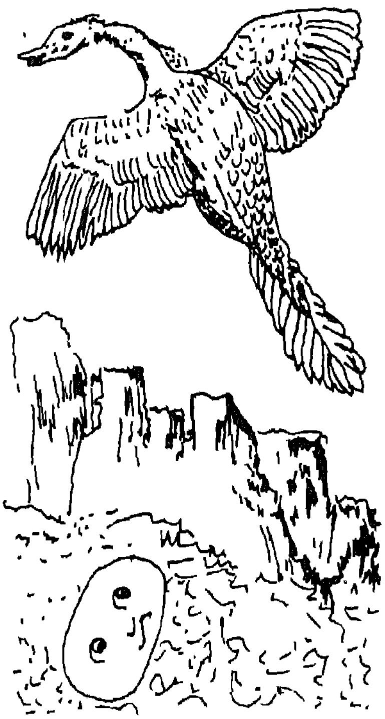
"Thus I came to a brief respite from the wanderings of ages, but my journey's end was not yet.

"Amid all my peregrinations so far, since the infancy of the earth, what worlds of living beings both plants and animals, I have beheld! Let me tell you briefly of some of the more remarkable of these inhabitants that successively peopled the earth. In the early part of the narrative I have told you of the impoverished conditions of the world when I was born in the era, known in Geology as the Paleozoic era. All the organic creation was then primitive, simple and generalised, in contrast with the varied and more specialised fauna and flora of today. In them, it almost seemed Nature had tried her 'prentice hand'. But as this time passed, new animals appeared and the older tribes died out, never again to appear. One notable feature of these successive creations was the progression from lower to higher types of animals as well as plants, species multiplied and the general total of life forms became more varied but less cosmopolitan. The first important advance, since my days, was the appearance of Fishes of a great variety of size and structure. They were quite unlike the modern fishes, and their curiously shaped bodies were encased in large plates of bone. Passing beyond the 'age of Fishes', the next remarkable period - the Carboniferous period of geological history — was one in which frog-like creatures appeared for the first time. The landscapes of the time were being rapidly changed now by the profusion of vegetable life, which flourished in rank abundance, thick matted jungles of ferb and horsetail on every foot-breadth of the soil.

But from these woodlands anything

higher than the seed fern type of vegetation was absent; their gloomy monotony being broken by huge frog like creatures — the highest class of animals then living — that hunted them Their disproportionate and ungainly bearing ill suited their dignity as the monarchs of the animal world This period of vegetable supremacy having closed with the Carboniferous, there next came a period in which enormous Reptiles were the order of the day. But of these times — the Mesozoic — I have no personal knowledge, being buried on oblivion deep under the bowels of the earth, as I have just said My neighbour, this block of limestone, is of Jurassic limestone parentage and tells me the story of his times. He even possesses, entombed within him, many previous relics of the life of those days. In the air, on the land, and in the water there were reptiles of monstrous sizes and shapes. Those weird, uncouth giants then fulfilled by means of their various structural adoptions the offices now held by mammals You cannot imagine a lizard as large as an elephant, yet the *Iguanodon* fully equalled, if it did not surpass him in size One singular creature — the *Plesiosaurus* — was truly the monarch of the seas With the head of a crocodile it carried a neck which resembled the entire body of a python, a trunk like a bison, the ribs of a lizard and the paddles of a whale. A fish-like dragon the dreaded *Ichthyesaurus*, more than 30 feet in length, traversed the depth of waters in search of food, that half killed its prey by the stony stare of its eyes, which were a full foot in diameter Winged dragons, the *Pterosaurus*, careered through the air and filled the landscapes with their curious forms The Jurassic and Cretaceous rocks of all parts of the world are full of proofs of what I say, for they contain enclosed within them the petrified bones and other remains of all these strange creatures.

"But before the Mesozoic era closed, this over-grown class of reptiles had all but passed away The very advantages which gave them superiority over the other races in their day, viz., their large size and highly specialised organisation, unfitted them to withstand the rigours of altered circumstances which the succeeding age brought, and they lost in the keen race for struggle for existence against the less specialised but more hardy and agile races Before they became extinct, a new and higher class of animals had emerged on the stage of creation, the class of Birds. Wonderful as it may sound, the birds originated directly out of the reptiles. First there were bird-like reptiles and then there came true birds but with several reptilian characters The first such type that arose — the one known as *Archaeopteryx*, in the barbarous terminology of geology, had, instead of the graceful beak of the living birds, formidable jaws set with rows of sharp teeth, and possessed a long tapering tail like that of a lizard



"Followed the Cainozoic era — the era of modern creation with many living orders of animals and plants, the era in which immense Mammals were the kings of the earth The old-world families and orders of fishes, amphibians, reptiles and birds had become extinct and their place was taken by newer and more modern forms. The earliest progenitors of the mammals were the Marsupials and their allies. These early quadrupeds had combined in them characters and structural plans of many widely separated orders which were to come later in time Each succeeding epoch introduced new forms more and more like the living denizens of the world of the today. The great carnivoros, horse, pig, camel, elephant, rhinoceros, hippopotamus, cattle, deer, and ape came in due time: the grand march of life continued, till almost at the close of the era, came Man at the head of the procession, the last-comer on earth of all its animals Man's entry on the stage of the world was co-eval with an extreme change in the climate. Sheets of ice covered the northern world, while even down to north Punjab, rivers of ice flowed down draining the vast ice-caps of the highlands. This refrigeration slowly culminated into an Ice Age for the whole of the northern world down to the latitude of 39 degrees, as the Himalayas completed their elevation Then the ice slowly retreated and the climate became milder

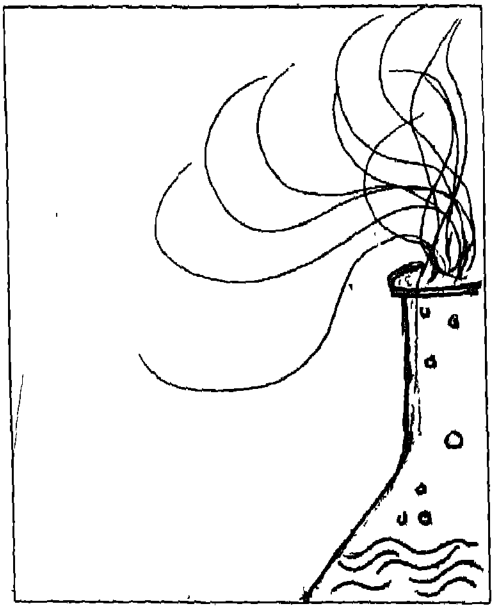
"In the preceding narrative I have given you brief outline of my autobiography My future I begin to perceive dimly, though yet in a far distant age. Do you hear the roar of the river water? It is the requiem being sung by it as it carries many of my brethren to their doom — their dismemberment into fine impalpable silt. The same fate awaits me as sure as death. For look at the river-bed and you will discover what is going on there. Myriads of the boulders and pebbles from this place are torn from their site by its hundreds of tributaries in the monsoon, and are being carried away grating against one another and against the floor They are pushed on till the burden is transported to the Jhelum, to undergo the same grinding; till the Jhelum in its turn transfers it to the Indus There mingling with its own enormous load of sediment, washed away by itself and its hydra-headed tributaries from the uplands and plains of northern India, it is propelled onwards Big boulders are reduced and rounded into small ones, these into pebbles, the pebbles are again ground are still further reduced or decomposed into the finest particles of silt and clay When the Indus's journey is finished, the whole freight is discharged at its mouth into the Arabia Sea, pebble, sand, and silt, there in its tranquil depths to rest for a time in horizontal sheets and layers on its floor Out of these are formed the future sandstone, conglomerate and shales, the bricks and mortar of new lands These will, on some distant day, be uplifted from their depths, and out of their ruins again, will be built newer lands, mountains and continents Thus the process goes on in Nature in a never-ending cycle, decay and renovation succeeding one another as they have done again and again in the past, as this narrative of my humble — because of a mere stone's — existence has shown you".

Reader, in this story of the humble pebble of stone we have learnt some lessons in Geology, and got some insight into the hidden ways of Nature

(P S -The pebble, the subject of the above narrative, is of white quartzite of older Paleozoic age occuring in the Pir Panjal range of Kashmir. Such pebbles occur commonly in the Siwalik deposits (late Tertiary) of the Himalayan foot-hills along their entire length from the Punjab to Assam.

A Comparative Study of the Performance of Students at +2 Stage in Chemistry – Isomerism in Carbon Compounds

DR V P GUPTA
Reader in Chemistry
Regional Institute of Education
NCERT, Bhopal - 462013



All the states and Union Territories in India have adopted the 10+2+3 pattern of education. The chemistry curriculum at +2 stage has also underwent tremendous change to keep pace with the developed countries. Previously, chemistry in general and the chemistry of carbon compounds in particular used to be considered as a subject for cramming. Many Board examinations also laid emphasis on recall of definitions and the facts but now there is a shift from knowledge to understanding and application type questions. To test how do the students at +2 stage perform and what type of mistakes do they commit at +2 stage in different concepts of chemistry, question bank of test items on different topics of chemistry have been prepared by the author and the tests have been administered to the students . The present paper deals with the performance of students in different concepts of the topic entitled, "Isomerism" in Carbon Compounds" A comparative study of the achievement of children of different schools on this topic forms the basis of this paper.

Objectives

The study has been conducted keeping the following objectives in view :

(i) to compare the achievement of boys and girls on knowledge, understanding and application type of items separately.

(ii) to assess the difference in the overall performance of boys and girls.

Hypotheses

The following hypotheses have been assumed for the above study :

I The female students fair better than male students in knowledge type test items.

II (a) The performance of male students is better than the female students in understanding type test items.

(b) The performance of boys is better

than the girls in application type test items

III The overall performance of female students is better than the male students

Sample

The sample consisted of 100 boys and 50 girls studying in Class XI of different English medium Co-educational schools (State and Central Govt. and Private management schools) of Bhopal city of Madhya Pradesh State of Central India . The average age of male students was 16 5 years and that of female students was 16 3 years The average percentage of marks secured in Class X public examination by the male students was 73 6 and that of the female students was found as 75.4 i e all the students had obtained first division in Class X The topic on isomerism in Carbon Compounds is covered in both state and central·Govt. run schools. The total number of periods allotted to chemistry subject is also the same i.e. 10 periods per week. It was also ensured that the teachers were post-graduate trained teachers and they followed the same medium of instruction i e the English language

Methodology : Components of Syllabus Tested

After careful analysis of the topic on isomerism covered in the chapters of hydrocarbons and halogen derivations of alkanes and arenes from different books of Class XI and Class XII (1-5) the following concepts were identified

1 Essential condition for Isomerism
2. Causes for structural Isomerism
3 Types of structural Isomerism
4 Identification of chain, position and functional isomers
5 Distinction between Metamers and Tantomers
6 Causes of stereoisomerism
7 Types of stereoisomerism
8. Restricted rotation around C=C bond and C=N bond in alkenes and oximes and C=C bond in cyclic compounds
9 Identification of Geometrical isomers
10 Chirality in optically active isomers
11. Identification of optical isomers
12. Resolution of optically active isomers
13 Optical inactivity of mesomers
14 No of structural isomers for a particular m f.
15 No of structural and geometrical isomers for a particular m f
16 Identification if isomerisms a synthetic compound.

Based upon the above concepts, 45 multiple choice test items on isomerism were developed and are given under clinical testing of items The students of the selected schools were given an advance notice of one week to prepare for the test. The test on 45 test items was of 45 marks and the time allotted for the test was also 45 minutes. The test was administered to the students in the month of November'95 when these concepts has already been taught in all the schools Chemistry teachers of the respective schools were also associated during the administration of the test.

Achievement Test

Based upon different concepts and sub-concepts on the topic of isomerism in carbon compounds, 45 test items were developed All the test items were of multiple choice having four alternatives with only one criterion response More than one test item were prepared on a single concept to bring variety in the items and to check whether the students respond correctly with minute variation in stem of the question. Out of 45 test items, 11 were of knowledge type, 27 of understanding type and 7 of application type. The major item content of all the 45 test items is given in Tables 1.2, 1.3 and 1.4 under clinical analysis of test items.

Analysis

For assessing performance of students, each test item has been given one mark. Negative marking for wrong response has not been done. Each correct response has been awarded one mark and the wrong response zero. Thus the test paper was of 45 marks and the score of each student has been determined out of 45 marks. The data have been pooled itemwise. Itemwise percentages of correct responses for both boys and girls have been computed separately for knowledge, understanding and application type items. In knowledge type items, the mean score is out of 11 marks, in understanding type out of 27 marks and in application type out of 7 marks.

Gender Differences

Gender differences have been determined in terms of knowledge, understanding and application level of students with the help of 't' test (6) and percent correct responses. Overall performance of boys and girls in all the 45 test items has also been assessed. Mean score, S.D and 't' values and average percent correct responses of the students in all the above mentioned abilities have been given in Table 1.1

Knowledge Level · The test consisted of 11 test items (25%) at knowledge level. From the values given in Table 1.1 it is clear that the mean score of girls (4.82) is better than that of boys (2.38). Average percent correct responses in case of girls have been found as 48.55 as compared to 28.91 of boys i.e. girls have done better as compared to boys. Statistical analysis reveals that the 't' value for df 148 is found to be of the order of 2.93 which is higher than the table 't' value of 2.35 at .02 level and 2.61 at .01 level indicating that there is a significant difference in the performance of students at all levels and swing being in favour of girls. *Hence hypothesis No.1 that girls do better than boys in knowledge based items is retained.*

Understanding Level · 27 items (60%) were of understanding type. Performance of boys and girls in terms of their

TABLE 1.1

Comparison of Performance of Boys and Girls

Ability	*No of items*	*Sex*	*N*	*Mean*	*S.D*	*'t' value*	*Difference*	*Percent correct responses*
Knowledge	11	Boys	100	3.38	1.81	2.93	Significant	28.91
		Girls	50	4.82	3.21		(p < .01)	48.55
Understanding	27	Boys	100	8.21	3.78	4.28	Significant	30.48
		Girls	50	10.64	2.96		(p < .01)	39.41
Application	07	Boys	100	1.13	1.02	2.35	Not Significant	16.54
		Girls	50	1.52	0.92		(p > .05)	21.43
Overall	45	Boys	100	13.35	3.93	5.40	Significant	27.93
		Girls	50	19.00	6.79		(p < .05)	38.84

mean score S D , 't' values and percent of correct responses is given in Table 1 1 In these items, the mean scores of boys and girls out of 27 marks have been found as 8 21 and 10.64 with S.D. values as 3 78 and 2 96 respectively The 't' value for df: 148 is found to be of the order of 4 28 which is much higher than the table 't' value of 2 61 at 01 level Hence there is a significant difference in the performance of boys and girls, the tilt again being in favour of girls This is further supported by the average percent correct responses which is 39 41 in case of girls and 30 48 in case of boys *Hence statistical data reveals that hypothesis No II (a) that the performance of boy students in understanding type test items is better than girls is rejected*

Application Level: Only 7 items (15%) had been framed for the test to check the application level of students i.e whether the students can really attempt better on coming across to totally new situation on the basis of their knowledge and understanding. The mean score out of 7 marks, S.D 't' value and percent correct responses of boys and girls are given in Table 1.1 From the data given in the table, it is amply clear that on an average out of 7 test items only one could be attempted correctly by boys whereas girl students did slightly better The 't' value for df: 148 is found to be 2 35 which is lower than the table 't' value of 2.61 at 01 level but equal to the value of 02 level meaning thereby that there is no significant difference in the performance of boys and girls at 02 level *On an average only 16.54 percent boys have written the correct responses, as compared to 21 43 percent of girls Though there is a slight swing in favour of girls but no significant difference at .01 level. Hence hypothesis II (b) that the performance of boys in application type items is better than girls in rejected*

Overall Performance · On pooling all the correct responses of the students, the performance of girls has again been found better *The 't' value of 5 40 and other data given in Table 1 1 indicate that there is a significant difference in the performance of boys and girls and tilt is in favour of girls Thus hypothesis III that the overall performance of girls is better than boys is retained.*

Clinical (Itemwise) Differences Clinical analysis of individual test items has also been done to find out difference in the performance of boys and girls For this purpose, analysis has been done separately for knowledge type, understanding type and application type test items The differences have been measured in terms of percentage of correct responses separately by boys and girls.

Itemwise analysis has been done under the following three heads —

Knowledge based Test Items Eleven test items no. 1, 2, 3, 5, 8, 11, 12, 22, 30, 31, 32 and 38 were kept in the test paper to test knowledge part of the students. These were based upon facts, information, definition, recall etc On an average only 28 91 percent of boys and 48 55 percent of girls could attempt these items correctly Itemwise percent correct responses of the above items are given in Table 1.2.

The weakest position of boys has been found in the concept of resolution of a racemic mixture into d and l forms (Item No 8) wherein only 15 percent of the boys could give the correct response. In case of girls, writing of structure of

TABLE 12

Comparison of Students in Knowledge based Test Items

Item No	*Item*	*Correct Responses (percentage)*	
		Male	*Female*
1	Causes of optical isomerism	16.0	50.0
3.	Naming of Functional isomer of Ethanol	45.0	48.0
5.	Structure of Functional isomer of Ethanol	17.0	20.0
8.	Phenomenon of Resolution	15.0	56.0
11	Essential condition of same m.f for isomerism	55.0	86.0
12	Isomerisation of conversion of NH_4 CNO to H_2 $NCONH_2$	22.0	38.0
22.	Essential condition of same molar mass for isomerism	39.0	68.0
30.	Instrument for distinguishing optical isomers	27.0	46.0
31	Optical inactivity of racemic mixture due to internal compensation	25.0	40.0
32	Asymmetric carbon atom responsible for optical isomerism	33.0	40.0
38	Tautomeric forms of Aceto acetic ester	24.0	42.0
	Overall average % of Correct Response	28.91	48.55

functional isomer of ethanol proved to be the toughest concept wherein only 20 percent of them attempted the question correctly. Only 17% of the boys gave correct response in this item.

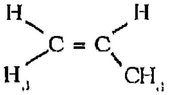
The essential condition of same molecular formulae for isomerism (Item No.11) has been found as an easy item in which 55% of boys and 86% of girls responded correctly. Item no.3 and 5 are almost the same. In item no.3, name of isomer of ethanol has been asked whereas in item no 5, structure of isomer of ethanol is to be identified. By changing the stem of the item from name to structure of isomer of ethanol the percentage of correct responses decreased appreciably from 45 to 17% in case of boys and from 48 to 20% in case of girls from item no 3 to item no.5. Similarly item nos 1 and 32 are almost the same. In item no.1, presence of four different atoms/groups attached to the same carbon atom has been taken as the real cause of optical isomerism whereas in item no.32, it has been replaced by the word asymmetric carbon atom', In case of boys the percentage of correct response decreased from 33.0 in item no.32 to 16.0 in item no 1. This may be due to the fact that the term 'Asymmetric carbon atom' is commonly used in books and explanation of the term did not help the boys to really understand the cause of optical isomerism. Almost the same trend has been observed in items no.11 and 22. Simple change of term, 'the same molecular formula' in item no.11 by the same relative molar mass in item 22 reduced the percent of correct responses appreciably from 55.0 to 39.0 in case of boys and from 86.0 to

68 0 in case of girls. Thus it can be inferred that even in knowledge type items change of terms connoting the same meaning changes the responses to a great extent.

Understanding Based Test Items 27 items 2, 4, 6, 9, 10, 13, 14, 15, 16, 17, 18, 19, 21, 23, 25, 26, 29, 33, 34, 35, 36, 37, 39, 40, 43, 44 and 45 were of understanding type An effort has been made to

TABLE 1.3

Comparison of Performance of Students in Understanding Base Test Items

Item No.	*Item Content*	*Correct Responses (per cent)*	
		Male	*Female*
2	Name of isomerism not found in alkenes	24 0	40 0
4	Identification of geometrical isomerism in derivatives of propane, butane and pentane	45 0	64 0
6	Essential condition for stereoisomerism	40 0	48 0
9	Identification of optical isomer (out of 1-Butanol, 1-propanol, 2-chlorobutane and 4-pentanol)	24.0	40.0
10	Identification of chain isomers	50.0	56 0
13.	Identification of optical isomer out of tert butyl alcohol, isobutyl alcohol, n-Butyl alcohol 1-chloro-1 butanol)	9 0	22.0
14	Identification of Metamers	21.0	26.0
15	Position isomers of Propanol	29 0	38 0
16	Position isomers of nitrophenol	36 0	46.0
17	Identification of isomerism in butene-2	68 0	48.0
18.	Naming of isomerism in 	42.0	60.0
19	Naming of isomerism in $H_3C-CH=CH-CH_3$	24 0	52.0
21	Identification of geometrical isomerism in acetylene and ethylidene derivatives	34.0	42 0
23	Identification of optical isomerism in different butanols	18.0	46 0
25	Isomerism in lactic acid	35.0	42.0
26.	Identification of compound (lactic acid) showing optical isomerism	43.0	40.0
29	No of isomers in C_7H_7Cl	27.0	22 0
33.	Difference between tautomers & functional isomers	24.0	28.0
34.	Chirality in organic molecules	18.0	30.0
35.	Identification of geometrical isomer out of 2-Butene, 2- Butanol & 1-Butanol	23.0	42.0
36.	Identification of optical isomer from a given set of compounds	33 0	24.0
37	Identification of metamers	31.0	48.0
39	No. of structural isomers to $C_2H_2Br_3$	53.0	40.0
40	No. of structural isomers for $C_2H_3Cl_3$	27.0	22.0
43.	No. of open chain structural isomers for C_4H_6	22 0	38.0
44	Compound non-isomeric with diethyl ether	22.0	16.0
45	Identification of geometrical isomer out of 2-Butyne, 2-Butanol C_6H_5-CH=CH=COOH and 1-Butanol	23 0	44.0
	Overall Average Percent correct responses	30.19	39.41

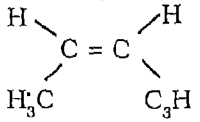
check the understanding level of the students with the help of these items. Percent correct responses of boys and girls,on these items have been given in Table 1 3 .

On an average 30 19 percent of boys and 39.41 percent of girls could attempt the above items correctly. Amongst these items item No 13 on identification of optical isomer (out of tert butyl alcohol, isopropyl alcohol, n-butyl alcohol and 1-chloro-1-butanol) has been found very difficult for boys with only 9 percent correct responses whereas 22 percent of the girls could attempt it correctly Item no 44 on identification of compound non-isomeric with diethyl ether proved very tough for female students in which only 16 percent of them could give the correct answer as compared to 22 percent of the boys

In ten items namely identification of optical isomerism in different structures of butanol (Item 23), Chilarity in organic molecules (34); identification of metamers (14); No. of open chain structural isomers for C_4H_8(43); identification of geometrical isomer (out of 2-Butyne, 2-Butanol, C_6H_5CH=CH=COOH and 1-Butanol) (45) and similar item on identification of geometrical isomer (out of 2-Butyne, 2-Butene, 2- Butanol and butanol) (35); difference between tautomers and functional isomers (33); naming of isomerism in CH_3CH=CH-CH_3 (19); naming of isomerism not found in alkenes (2) and identification of optical isomer out of 1-Propanol, 1-Butanol, 2-Chlorobutane and 4-Pentanol (9) only 22 to 24 percent of boys have given the correct response The performance of female students in these ten items is found much better as compared to boys where the correct responses ranged between 26-52 percent

Fifty percent boys and 56 percent girls have given the correct responses for the item on identification of chain isomers which is comparatively a simpler concept 53 percent of the boys could identify the number of structural isomers for $C_2H_2Br_2$ correctly as compared to 40 percent of girls

Three test items nos. 17,18 and 19 had been framed on identification of isomerism in butene-2 by writing it in three different ways i e butene- 2(17) .



(18)

and H_3C-CH=CH-CH_3 (19). It has been found that max. number of students (42% boys and 60% girls) and given the *correct response form items no 18 in which the structure has been written very clearly meaning thereby that clarification of structures of molecules makes the concept simpler and easily comprehensible.* This inference is further supported by item no 13 in which only names and not structures of alcohol had been given and the response of the students has been found very poor with only 9% boys and 22% girls responding correctly.

Item no 29 on number of isomers in C_7H_7Cl also involves understanding of different structures of position isomers and has been poorly attempted by the students in which only 27 percent of boys and 22 percent of girls could attempt it correctly. Thus it is *inferred that understanding of carbon compounds can be accelerated by asking the students to practise for writing structures of the compounds*

Application Based Test Items :Only seven items no.7, 20, 24, 27, 28, 41 and 42 were of application type i e only 15% of the application based items were kept in the test Percent correct responsesfor these items ranged between 5 0 to 25 percent in case of boys and from 8.0 to 40 0 percent in case of girls i e. none of the items could be attempted correctly by more than 25% of boys and 40% of girls. Percent correct responses of these seven items are given in Table 1 4.

From item no 7 in Table 1.4 , it is inferred that identification of a compound obtained as a result of different steps synthesis and isomerism therein proved a very difficult task for the students as only 5 percent of boys and 18 percent of girls could attempt it correctly. Similarly the phenomenon of Mesomerism and resolution (Item no 28) and determination of number of isomers — structural and stereo for a given m.f. (20.27) also proved a difficult area where only around 20% of the students could reach the criterion response. *Such items can be at- tempted correctly only by those students who have really understood the tetravalency of carbon and framing of different structures for compounds and having the same mf but different properties.*

TABLE 1 4

Comparison of Performance of Students in Application Based Test Items

Item No.	*Item Content*	*Correct Responses (percent)*	
		Male	*Female*
7.	Identification of isomerism in a synthetic compound	5 0	18 0
20	No of aliphatic isomers for C_4H_8	20.0	22 0
24.	Identification of the optically active isomer out of aliphatic and heterocylic compound	28 0	24 0
27.	Type of isomerism in compounds with m f. C_4H_{10}	18.0	26.0
28	Mesomerism Vs Resolution	15 0	12 0
41	No. of structural isomers for open chain alkene of m f C_5H_{10}	25 0	40 0
42.	No of structural isomers for C_4H_8	15.0	8 0
Overall Average Percent Correct Responses		16.57	19.71

Conclusion

The comparison of performance of boys and girls in the topic on 'Isomerism in carbon compounds' reveals that there is a significant differences in the performance of boys and girls in knowledge as well as understanding based items In these two areas statistical differences have been found in favour of girls. In application based items boys and girls have done very badly wherein the average mean score out of 7 marks is found as 1.13 in case of boys and 1.52 in case of girls. On an average only 16.54 percent of boys and 21 43 percent of girls have given the correct responses. Analysis of data have [illegible] in [illegible] of dif[illegible] ge type items attempted correctly by 50 percent of students, understanding type by 40 percent of students and application type attempted correctly by 25 percent students correctly have been termed as the difficult items and are given below .

Except item no.11 on "Essential condition of the same m.f. for Isomerism, all other ten knowledge based items proved difficult for the students. In case of understanding type items except items no.4,6,10,18,26 and 39 all other 21 items fall under the category of difficult items as none of them could be attempted correctly by more than 40 percent of students.

Only one item no.41 out of the seven application based items could be responded correctly by 25 percent of boys and 40 0 percent of girls Responses in all items remained very poor

Keeping the above results in view, the teacher are requested to pay special attention to the following components of the chapter on isomerism .

Causes of optical isomerism & identification of compounds showing optical isomerism
Cause of optical inactivity of meso forms
Resolution of d & l isomers from the dl mixture
Isomerism in alkanes and alkenes
Causes for geometrical isomerism and compounds showing identification of geometrical isomerism
Metamerism and identification of Metamers
No of isomers and their structures corresponding to a particular m.f
Difference between tautomers and functional isomers
Chirality in organic molecules

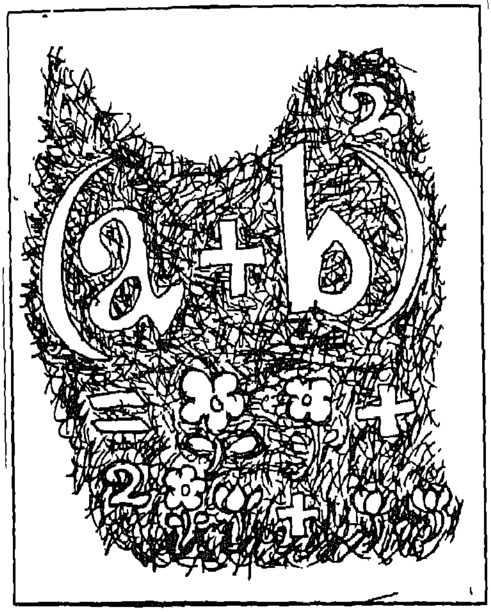
It is suggested to use the ball and stick models to derive different isomers corresponding a particular m.f. The students may practise to derive different arrangements both structural and configurational using different permutation and combination. This will help the learners to understand the concept of isomerism and different types of isomerism when they will find themselves before their own eyes the formation of different compouns having the same number of carbon, hydrogen and oxygen atoms but different properties. More emphasis is also required on the explanation part of the technical terms like chirality, asymmetric carbon atoms, resolutions and practice of the detailed structures of compounds and explanation with the help of tetravalency of carbon atoms. It is hoped that by following these little suggestions, the teaching learning process of carbon compounds can be accelerated

REFERENCES

1 Chemistry — A Textbook for Class XI, Part II, 170-181 NCERT (1993).
2 Chemistry — A Textbook for Class XII, Part I, 150-173, NCERT, (1993).
3 Finar I L. Vol I, 1-192 ELBS , (1990).
4. Jain, M K., Organic Chemistry, 179-281, Vishal (1981)
5 Morrison, R.T., and Boyd, R N. Organic Chemistry, 75-111, 249-265, 297-335,415-427 Prentice Hall of India, (1989)
6 Garett, H.E , and Woodsworth, R S Satistics in Psychology and Education, 461, Vakils Feffer and Simons Ltd (1981)

Logico-Mathematical Errors – An Analysis

G.C.PAL, H C. PRADHAN, CHITRA NATARAJAN
Homi Bhabha Centre for Science Education
Tata Institute of Fundamental Research
Mumbai 400 088



Errors are normal occurrences in the process of learning. Certain types of mathematical errors are continually repeated by students due to the uses of flawed procedures which are quite unrecognized by the teacher. To make accurate inferences about the state of the underlying knowledge structure is virtually impossible without an extended error analysis Observable errors, provide insights into the learning process and an analysis of the nature and pattern of students errors potentially useful for devising more effective teaching strategies. Error analysis is a method of inferring the information process path or about the nature of mental process in mathematics thinking As stated, errors represent a window through which glimpses of mental functioning can be obtained (Fisher and Lipson, 1986) They indicate some misconceptions about fundamental aspects in mathematics (Kar, 1993)

Large number of typical errors are documented in the literature (Young, 1981); Keedy, 1983, Marquis, 1988, Parish and Ludwig, 1994, Ben-Zeev, 1995). A few classes of errors have been widely recognized These include slips (occasional errors) and bugs (persistent errors) in performance of procedural skills (Fisher and Lipson, 1986). The sources of errors serve to emphasise the need for teachers to ask right questions and take necessary remedial steps It can guide teachers in targeting their lesson plans. By better understanding students' constructs in a particular domain and by designing teaching methods that address these constructs, one can become more effective teacher. A student can use his/her errors to develop a deeper understanding of a concept as long as the errors can be recognised and appropriate informative feedback can be obtained Simple telling students the right way is not enough to eradicate the deep-seated misconceptions. The task is to identify the error, explain the right approach and also suggest how the misconceptions arose The present study attempted to study the errors done by primary students on each concept of mathematics in Minimum Levels of Learning (MLL) curriculum and analyzed the nature and sources of errors.

Method of Study

The standardised Mathematics Achievement Test (MAT) based on the MLL curriculum formulated by the National Council of Educational Research and Training (NCERT) was administered to 326 students of Grade IV inMaharashtra The students were required to respond the mathematics items using multiple choices. Instructions were followed by blackboard illustrations. Students were instructed not to linger on any question, if they were not able to solve it. They were told to do rough work on the space provided against each question and could use backside of the page if needed. Individual help was rendered to students who had doubts Enough time was given both for the students to understand the examples and for completing the test. The nature and possible origin of errors were identified based on the observations of procedures that the students adopted to solve the problem (available from the note sheets), and through informal discussions with students. In some cases the procedure followed by students for a particular problem leading to wrong answer were not clearly marked from the note sheets (the space available against each item to be used for rough works). This led to seek students' help and the concerned students were interacted carefully to introspect the methods that they adopted to solve the problems. The interaction of this type with about 20 percent of the error makers provided a lot of insights to understand the causes of errors. Arguments made by the students were analyzed critically and the type of error was named depending upon its origin.

The mathematics items presented below would represent a sample of the error types which had been observed in the classes of primary schools. It was not possible on that part of researchers to observe and analyze errors in all mathematical areas at primary levels due to time constraints and insufficient clues available from note sheets and students' report. Still the errors observed in some specific mathematical problems related to some selected areas of mathematics would ask for due consideration.

Analysis of Error

1. How is 79 written in words? The four response categories from which students had to recognise were—(1) Ekonanawad, (2) Ekonaishi, (3) Ekonasattar, and (4) Ekonasath. The correct response (no.2) was given by about 70 percent of the students. The wrong answers mainly revolved around the response category of no 3 About two-third of the error makers responded on this. The majority of the students committed error by finding a familiarity between the digit 7 as 10th unit in 79 and the word sattar in the word of *ekonasattar*. Some other students (about 9% of the error makers) did mistake by equating the digit 9 to 79 with*nawad* in the word of *ekonanawad*. Thus, the error in this case produced by associative properties of mathematics terminologies in relation to digit numbers.

2. On place value, the question read like 'what will be the number when its 10th unit digit is zero, unity digit is, 9 and

100th unit digit is 1? While one-third of the students could answer correctly, about 18 percent of the students could not answer. Of the error makers, more than two-third answered as 190 These students even were able to write a three digit number correctly but they did not have clear understanding of the place value. In the above case, they wrote the digit serially as per usual practice of writing a three digit number. But the question here might be that 'why they then did not start from left side as 091 rather from right side as 190? The possible answer here is that, they are very much aware that writing zero in left has no value, as such put it in the right side and move towards left by putting 9 and 1 serially Of the error makers, about one- fourth answered as 901 Here these students perhaps could trace out the 10th unit as middle digit but got confused over unity and 100th unit whether to be put in left or right Since they usually start from the left, put 9 in the left as it was asked first and 1 in the right side of the zero. It was felt that the error in this case caused by the confusion over the recognition of unit place because of day to day practice of writing from left. This may have implication on teaching the place value Teacher should not get confirmed that once the students are able to write a multi-digit number as per pronunciation, has understood the concept of place value. The multi-dimensional exercises could help teachers to understand the problems and accordingly could take the remedial measures. According to the theory of learning, learning through discrimination helps in better conceptualization (Heidbreder, 1947). The exercises of various types where students have to identify the unit place of a number or vice versa, therefore, could help students for better learning.

3 What is the addition of these number?

$$\begin{array}{r} 5 \\ +69 \\ +796 \\ \hline \end{array}$$

It was seen that those who did incorrectly (about 20%), answered 860 and 850. Among these students a little more than half answered on 860 and remaining on 850 It was found out that those who answered 860, the error was mostly due to predominant tendency of carry over of 1. The main criterion that when the addition of digits give a number more than 10, carry over starts. This idea dominates while solving a problem involving a carry over While a few of the students showed, the way they did this problem it was noticed that in a natural way they uttered the digit 1 while adding the carry over digit with the 20th unit digits, even the adding of digits of unity gave the number 20 This was very much psychological in nature and found consistent with the essence of learning theory that a 'core principle' sometimes dominate to influence the later learning. The other group who showed 850 as result, the error was essentially a practice error. It was seen that almost all students who answered correctly write the additional 2 of first column addition on the above of the second column and add it with other digits while start on second column. But most of the error makers of 850 were not habituated in writing this way As a result they forget while adding the digits of second column This might have an implication on the classroom practice Teachers should make it a point so that every student should write the additional values on the above of left side column, especially in the early stage when the concept of carry over is taught.

4 On subtraction problem as given below, only 40 percent of the students had a correct answer Other responses falling on wrong answer categories showed that the main problem in subtraction was related to 'borrowing' and especially when 'zero' involved The problem reads like—

What is the subtraction of this ?

$$\begin{array}{r} 806 \\ -168 \\ \hline \end{array}$$

The wrong answers of 738 and 648 were most common. The interaction with the students on this problem led to conclude that students knew 'borrowing' but they misunderstood that from immediate next column digit it could be borrowed. When a problem with the involvement of 'two digits' and 'no zero' was given they could solve it correctly. The misconceptions related to zero therefore, need special attention Another peculiarity was noticed with some of the students. They borrowed from third column for the first column finding zero in between which is perfectly correct but they did not understand what would happen to zero when borrowing was done crossing over it. The preconception that when numerator is less than denominator, there should be borrowing led them to borrow again for zero in second column. Secondly, the idea that you can borrow once from a digit led to make 8 as 7 not as 6 even after one 'wrong borrow' for middle column.

5 The error on the question related to 'multiplication with zero' yielded an important explanation The question like $23 \times 0 \times 9 = ?$ gave rise to the errors with highly cognitive explanation It was seen that the conception that developed by classroom instruction was very much logical but was found erroneous The expected answer to the above question could have been either zero (when properly learned) or 207 (when the role of zero is not learned), which of course was answered by about one-third of the students. But error due to the answer of 9 revealed that students' understanding and explanation was perfectly consistent with the classroom instruction. The argument that the teacher teaches the concept of 'multiplication with zero' This specific instruction remains a 'core principle' for the above problem According to the students' understanding when 'something (number) is multiplied by zero' the result is zero, but 'if the zero is multiplied by something (number)', it is not zero Therefore, when zero comes first and number second, it deviates from the 'core principle'. The result becomes equal to the number which is multiplied with zero by the application of another important principle that "when zero is in left, it does not have value" So, this must have definite implications on teachers' instruction related to multiplication and zero

6. In the problem related to conversion of addition and multiplication such as "how the addition of 7+7+ 7+ 7+ 7+ 7+ 7+ 7+' could be written in multiplication form. About 25 percent of the students answered as 7+7 and about 10 percent answered as 7+8 This error seemed due to inadequacy of conceptual understand-

ing that the result of addition of all digits will be equal to the result of its multiplication form

7. The error related to a problem of division was as follows. The question, i.e 808 ÷ 8 = ? exhibited error mainly related to the concept of zero. Majority of the students who did mistake answered it 11. From the procedural analysis, it was seen that the students after first step of division they get zero by the subtraction of 8 from 8 In the next step they bring the second digit i.e zero down They found two zeros after second step and the devisor can not be used In third step they bring the third digit 8 to down and find that the number is 008 They take out two zeros as they do not have value being in left side Now they divide the remainder by divisor by putting 1 in quotient, thus, adding one more 1 to the earlier one and the result is 11 The procedure is as follows—

```
8 | 808 | 11
    8
   ---
   008
     8
   ---
     0
```

In the second step the idea that "after bringing digit from dividing once, if the remainder still remains less than devisor the zero should be put in the quotient place", is dominated by the earlier learning that "zeros in the left side have no value" The error due to the above reason is found consistent with the idea of interference theory of memory

8. The students while answer the factual question in weight/measurement, the errors are assumed to be triggered by the confusion over unit place. In case of both litre and milli litre, and kilogram and gram, confusion was over 1000 and 100 unit place They answer 100 in place of 1000 The students think that the number system goes up to 100, therefore the maximum value in any unit of measurement can be 100 Students get confused over the number of factors involved in the unit of measurement like metre, centimetre, decimetre, litre, gram and so on, and the equations which usually ranges from 10 to 100 The errors in the area of weight/measurement are mainly rooted in this complexity. The teaching of this mathematical concept therefore, needs special attention.

9 On the problem related to time and period, it was seen that the difficulty of clock reading was more as compared to day and date, and hour and minute In clock reading, the error was produced by the students' wrong notion on direction of movement of hands and multiplication with 5 in case of minute hand To the time of 6 hour 25 minutes, about 22 percent of students recognised 7 hours 25 minutes whereas about 12 percent of the students recognised as 6 hour 5 minutes In both the cases the students have inadequate knowledge Moreover, they perhaps had not come across situations where this wrong notion could have been rectified by teachers. The learning of timing therefore, needs practical experience along with factual information.

10. Although, fraction was found most difficult area of mathematics at primary stage, the error observed here was perceptual in nature In a rectangle like figure, there were 6 equal segments and two of them were shaded. The students were required to find out the proportion of shaded portion to total figure The er-

ror was found in recognizing two shaded units as two separate units and taking them out from other four unshaded units, thus divided 2 shaded by 4 unshaded instead of total 6 units. Others took shaded portion as 1 unit and divided it by 4 clearly visible unshaded units and got a result of 1/4. So they did not perceive that on a ground of 6 units, 2 units were shaded, so 2 shaded portion has to be divided by the total of 6 units of the figure When the figure showed two different figural representations, the usual tendency of grouping in perceptual field operated to influence the mathematical reasoning, thus led to error.

11. Lastly, the error in the area of geometry was seen in a figure recognition problem. The error was related to identification of rectangle among other geometrical figures. The error was found rooted in the classroom instruction. The students were found having the knowledge of basic properties of rectangle by the presentation of figure from different angles —horizontal, vertical and angular, triggered the error Students identified the figure presented in horizontal way as the rectangle. Their answer was justified by the classroom instruction. While teaching rectangle, students were shown examples of rectangles in a horizontal way This figural knowledge of rectangle restricted the application of rules to the figures presented in a vertical and angular way Another type of error was produced by the process of generalization. Some of the students who could identify all rectangles, included the square with them by applying the rectangle rules.

From the above error analysis it becomes apparent that major aspects of the response error are rooted in an alternative understandable pattern of rules. The students try to bring their mind the procedure, the rules that they have learnt in previous class related to different mathematical concept. In reconstructing the rules in a different situation they create gaps with regard to concepts, rules and the steps of procedure. Very often these gaps are filled by the students in their own alternative ways, producing response errors. The present findings related to nature and origin of errors were found consistent with the findings of other researchers (Vanlehn, 1990 and Young, 1981). Errors were the result of incorrect induction from examples (Benzeev, 1995). Most of the errors identified in this study were produced by a process of dualism i.e. a different rule when zero involves as seen earlier in case of place value, subtraction and multiplication. It is also seen that errors are triggered due to inadequacy of language used in the definitions, rules or procedure names. Language inhibits the understandability. Most important are found to be inadequate instructions, interference between a prior belief and a new, conflicting set of beliefs to be learned, failure to verify a result, inability to focus properly or concentrate in a task, lack of students' centration on the perceptual field and the mathematical readability levels of instructional materials.

Conclusion

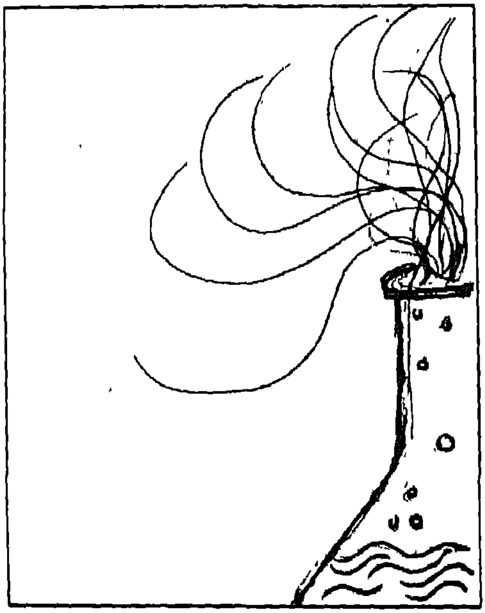
The error illustrated above may be of interest to teachers and parents who concern about the common errors their students/children make. It is realised that most of the errors were methodic and there are some understandable patterns in them Knowledge of these patterns may help in remediation of these errors. It is important therefore, to call for additional research into error diagnosis and their relation to language and other cognitive factors. Teacher training programme should incorporate this aspect so that teachers would be encouraged to look into students problems By focusing on errors and exploring, exploiting and learning to manage them, the student can generally arrive at a deeper and more lasting understanding than would otherwise to possible. Students learn more when they are provided regular and frequent opportunities to express themselves and to practice developing their own representations of the material they are learning As they express themselves, it is important that students receive feedback on their performances This instructional approach requires hard work, encouragement, effective role modelling on the part of the teacher, and creation of a supportive environment. Such an approach can provide a viable basis for solving the problem of what can be done to minimize the numerous potentially troublesome mathematical errors

REFERENCES

1. Ben-Zeev, T. (1995) The nature and origin of rational errors in arithmetic thinking · induction from examples and prior knowledge *Cognitive Science* 19, 341-376
2 Crouse R T & Sloyer, C W (1987).*Mathematical questions from the classroom.* Providence RI Janson Publication, Inc
3 Fisher, K.M & Lipson J I (1986) Twenty questions about students' errors *Journal of Research in Science Teaching* 23(9), 783-803
4 Heidbreder, E (1947) The attainment of concepts The problem *Journal of Psychology* 24, 93-138
5 Kar,.D K (1993) Mathematics education : introspective analysis and remedial measures. *Journal of Indian Education*, 19 (2), 23-27
6. Keedy, M.L.(1983). Thirteen things I wish teachers would not do*Indiana Council of Teachers of Mathematics Journal*, Spring, 8-14
7. Marquis, J (1988). Common mistakes in algebra. In the*Ideas of algebra*, K-12, (pp 204-205) Reston VA. National Council of Teachers of Mathematics
8 Parish, C.R. & Ludwig, H J (1994) Language, intellectual structure and common mathematical errors: A call for research,*School Science and Mathematics* 94(5), 235-239.
9 Vanlehn, K (1990). *Mind bugs. The origins of procedural misconceptions* Cambridge, MA · MIT Press.
10. Young, R.M. & O'Shea, T (1981) Errors in students' subtraction *Cognitive Science*, 5, 153-177.

Balancing Chemical Equations

J SEETHARAMAPPA, T.J VIDYAPATI
Regional Institute of Education
Mysore 570006



Writing chemical equations for reactions from the knowledge of (i) reactants consumed and products formed (ii) correct formula of each reactant and product and (iii) law of conservation of atoms and balancing the chemical equations and using them for calculations involving stoichiometry are the important aspects which form a part of chemistry curriculum at high school level. A survey conducted by the authors and the available research reports (1-3) revealed that the students and teachers consider balancing of chemical equations as one of the more difficult aspects of chemistry at high school level. Savoy (4) identified a number of chemical concepts along with their hierarchy which are essential to be understood by the students to successfully balance chemical equations Colin Hines (5) also supported that the eight concepts viz. atomicity, valency, use of brackets, subscripts and coefficients, molar-ratio, radicals and use of half moles listed by Savoy need to be thoroughly understood by chemistry students to achieve complete understanding of chemical equations. Pachaury (6) observed that the achievement score patterns for either gender does not support the contention that those students having higher achievement scores would be balancing more difficult equations than their peers having low achievement scores. The purpose of this study was to investigate into high school students' understanding of chemical equations within the framework of concepts listed by Savoy and identify students' difficulties in balancing them. A secondary purpose of this study was to investigate, if there existed, any gender difference and curriculum difference on balancing chemical equations

Method

Ten secondary schools from southern states of India (Karnataka, Andhra Pradesh and Tamil Nadu) were selected for the study Out of the ten schools, six schools followed curriculum prescribed by their respective states and the rest of the schools followed Central Board of Secondary Education (CBSE) prescribed curriculum The teachers concerned were asked to select at random some Class X students across the ability range of both sexes for administering the test The classification of students who have participated in the study is given in Table 1.

TABLE 1

Classification of students who participated in the study

Category	Number of Students
Boys	61
Girls	76
CBSE curriculum	44
State curriculum	93

The students were asked to complete two exercises The items in the exercises were so designed that the whole exercise can be completed in a period of 40 minutes.

Exercise 1 consisted of five chemical equations each containing a set of formulae errors The students were asked to spot the errors, correct them and later rewrite the equation in a balanced form.

Exercise 2 consisted of five equations of varying complexity and students were asked to balance them The items included under Exercise 1 and Exercise 2 are given in the Appendix

Results and Discussion

The results obtained were analysed to determined the percentage of successful, partially successful and unsuccessful students on Exercise 1 The Facility Value and Discrimination Index were also calculated. The analysis of the results on Exercise 1 are summarised in Table 2

TABLE 2

Analysis of results on Exercise 1 (N = 137)

Equation No	Percentage of A	B	C	Facility Index	Discrimination Index
1	42	29	29	0.42	0.81
2	23	07	70	0.23	0.70
3	07	07	85	0.07	0.24
4	04	01	94	0.04	0.16
5	15	04	81	0.15	0.46

Code A,B,C, refers to successful, partially successful and unsuccessful students respectively.

The analysis reveals that equation 1 was comparatively an easier item It was a deliberate attempt on the authors' part design an easy and simple item to see that the students are at their ease Equations 2 and 5 proved to be not very difficult. However, the Discrimination Index showed that these two equations are able to discriminate between the performance of successful and unsuccessful students. The equations 3 and 4 proved to be the most difficult ones for the group.

The findings from the performance of students in identifying and correcting the errors are summarised in Table 3.

TABLE 3

Students' performance in the identification and correction of errors

Errors	Categories 1	2	3	4
I	30	18	42	10
$CuSO_4$	22	18	40	20
$BaNO_3$	07	30	38	25
$Fe(SO_4)_2$	27	08	45	20
Ba_2SO_4	15	03	57	25
$K(OH)_3$	08	09	47	36
NaO	15	25	24	36
$Na(OH)_2$	19	11	33	37

Category 1: Identified and corrected;
Category 2 Identified but wrongly corrected;
Category 3· Not identified hence uncorrected;
Category 4· Not attempted.

Analysis of the results summarised in Table 3 indicate that the percentage of students who failed to identify and correct the errors was comparatively higher than the other categories This has promoted the authors to have a discussion session with the students to understand their difficulties in the identification and correction of errors The students' knowledge of chemical symbols, valencies of common elements and radicals, determination of chemical formulae from valency was especially sought for during the discussion About 26% of the students could not even identify the elements from their symbols Although many students had the knowledge of valencies of very common elements like sodium, hydrogen, chlorine, etc., about 40% of the students had the difficulty in expressing the valency of elements like barium, copper, iron, aluminium, potassium and of radicals like sulphate, nitrate, hydroxide etc. But, given the valencies, more than 50% of the students could write the molecular formulae The analysis of results from the performance of students on Exercise 2 is summarised in Table 4

TABLE 4

Performance of students on Exercise 2

Equation No	Percentage of A	B	C	Facility Index	Discrimination Index
1	61	15	24	0.61	0.35
2	51	23	26	0.51	0.38
3	49	17	34	0.49	0.30
4	68	11	21	0,68	0.35
5	47	22	31	0.47	0.41

A Successful students,
B . Partially successful and
C Unsuccessful

Table 4 shows that even simple equation like 4 was not balanced by all. While 68% of the students balanced it, failure of the rest of the students on such a simple item deserves a mention.

In equation 2, some students attempted to balance it as

$$2 Al_2 + 3 O_2 \rightarrow 2 Al_2O_3$$

by looking at the subscripts on the product side and placing the same numbers as coefficients on the reactant side also A few students completely ignored O_2 and tried to balance only Al on either side and vice versa In equation 5, as there are two phosphates in the bracket on the left side of the equation, many students placed two phosphates in the bracket on the right side also to get the equation $Ca_3(PO_4)_2 + 3 Na \rightarrow Na_3(PO_4)_2 + 3 Ca$ Indicating that the students have lack of knowledge of valency. The Facility Index indicates that majority of the items fell in the range of identical difficulty The Discrimination Indices reveal that most of the items can discriminate between strong and weak students to the same extent. The inability to balance many of the equations by about 25% of the students promoted the authors to conduct a post-test discussion with the students to find out the probable reasons The outcome of the discussion clearly supports the earlier findings (4,7-9) that the students possess a poor understanding of the concept of chemical sub-script of formulae and coefficients in equation. The students' knowledge of two rules for balancing equations was sought. It was observed that about 60% of the students were aware that there must be same number of atoms/elements on either side of the equation But, unfortunately, only 40% of them could visualise that the above rule is derived from the conservation law which governs all chemical reactions. Another major contributing factor for the incorrect balancing of equations was the liberal change of subscripts just to see that there are same number of atoms of elements on both sides of an equation. About 35% of the sample possessed a poor knowledge of the second rule for balancing chemical equations (subscripts should not be changed while balancing an equation). Tables 5 and 6 show the percentage of students (both gender wise and curriculum wise) correctly balancing the equations on Exercise 1 and 2 respectively.

TABLE 5

Performance of students correctly balancing the equations on Exercise 1

Equation	*Percentage of*			
No	*Boys*	*Girls*	*CBSE Curriculum*	*State Curriculum*
1	34	47	61	32
2	28	20	43	14
3	11	04	23	00
4	10	00	14	00
5	11	18	48	00

TABLE 6

Percentage of students correctly balancing the equations on Exercise 2

Equation	*Percentage of*			
No.	*Boys*	*Girls*	*CBSE Curriculum*	*State Curriculum*
1	64	59	91	47
2	56	47	89	33
3	56	43	70	39
4	69	67	93	56
5	58	41	77	33

The significance of difference between the mean scores of boys and girls and students belonging to CBSE and State curricula is given in Table 7.

The results indicate that there is no significant difference between the performance of boys and that of girls on both the Exercises. In particular, there is a close similarity in the performance of both the sexes as far as Exercise 2 is concerned indicating that both the groups have attained almost same competency in balancing the equations. However, the students of CBSE performed significantly better than the students following state curriculum (t = 7.98 and

TABLE 7

The significance of difference between mean scores of boys and girls and CBSE and State curricula students

	Exercise 1			*Exercise 2*		
Category	*Mean*	*SD*	*t*	*Mean*	*SD*	*t*
Boys	1.3016	1.3705	1.244 (ns)	3.3114	1.7822	0.8526 (ns)
Girls	1.046	1.0333		3.3046	1.8330	
CBSE	2.1477	1.5386	7.9815*	4.2159	1.2686	5.0128*
State	0.6989	0.5811		2.6989	1.8060	

ns : not significant ; * significant at 0.05 and 0.01 levels

5.01 for Exercises 1 and 2 respectively, df = 135) as evident from significant t values at 0.01 level. This could be due to several reasons. An observation made by the authors during their contact with the subject from the schools following state curriculum was that many from the sample were less motivated, lacked formal reasoning and appeared to be slightly below average in mental abilities as compared to subjects from CBSE schools. Another possible reason for the poor performance could be that the teacher-made routine tests are different from the one that was administered The routine class tests hinge more upon the information given in the textbooks and they rarely measure the knowledge related to the process of balancing chemical equations.

Conclusion

Our present study shows that high school students had difficulties in balancing chemical equations. The errors committed by the students while balancing equations were mainly due to the poor knowledge of valency of elements and radicals, significance of chemical subscripts and coefficients inequations and the rules for balancing the equations. Mansoor Niaz and Anton E Lawson (10) have reported that the balancing of chemical equations using the trial and error method requires formal reasoning and their general instructional recommendation for school teachers was the identification of topics that require formal reasoning and develop necessary reasoning skills in students Yarroach (8) has observed that students who wee successful in diagrammatic representation of the balanced equation also possessed good concepts of subscripts and balancing rules It would seem advisable to give high school students of exercises in the interpretation of symbols, formulae, valencies of common elements and radicals. The instructions should place more emphasis on explaining the significance of subscripts and coefficients and the empirical laws governing their use in balancing equations The evaluation procedures adopted by the teachers should be so designed that they not only measure students' abilities to balance equations but also their knowledge related to the process of balancing equations.

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REFERENCES

1. Ewing, A M. A preliminary study on the difficulty of certain chemistry topics, *School Science and Mathematics*, 1931, 31 (7), 872
2. Finley, F J Stewart and W Yarroach, Teachers' preception of important and difficult science content The report of a survey,*Science Education*, 1981, 66, 531
3. Stewart, A R, Studies of difficulties in chemistry,*School Science and Mathematics*, 1928, 27, 838.
4. Savoy, L G Balancing chemical equations, *SSR* 69, 713-720

5 Hines C Students' understanding of chemical equations in secondary schools in Botswna *SSR*, 1990, 72, 138-140

6 Pachaury, A C Balancing chemical equations by the ninth graders, *School Science*, Sept, 1994, 38-40

7 Schmidt, H J. How pupils think - empirical studies on pupils' understanding of simple qualitative relationships in chemistry, *SSR*, 1984, 66, 156-162

8. Yarroch, W L Students' understanding of chemical equation balancing, *Journal of Research in Science Teaching*, 1985, 22,449-459

9 Vidyapati, T.J and P.M Radhakrishna, Students' understanding of redox reactions, *SSR*, 1994, 75, 76-77.

10 Niaz, M and A Lawson, Balancing chemical equations · The role of developmental level and mental capacity, *Journal of Research in Science Teaching*, 1985, 22-41-51

APPENDIX

Exercise 1 Five chemical equations are given below You are required to spot the errors, correct them in the spaces provided and rewrite the equation in the balanced form

Equation 1: $H_2 + I \rightarrow HI$

Error Correction

Balanced form of the equation is · ....

Equation 2 $Cu_2SO_4 + Fe \rightarrow Fe(SO_4)_2 + Cu$ ....

Error Correction

Balanced form of the equation is ....

Equation 3 . $B_aNO_3H_2SO_4 \rightarrow B_a SO_4 + HNO_3$ ....

Error Correction

Balanced form of the equation is ....

Equation 4 · $Al(OH)_3 + K \rightarrow K(OH)_3 + Al$ ....

Error Correction

Balanced form of the equation is ....

Equation 5 $NaO + H_2O \rightarrow Na(OH)_2$ ....

Error Correction

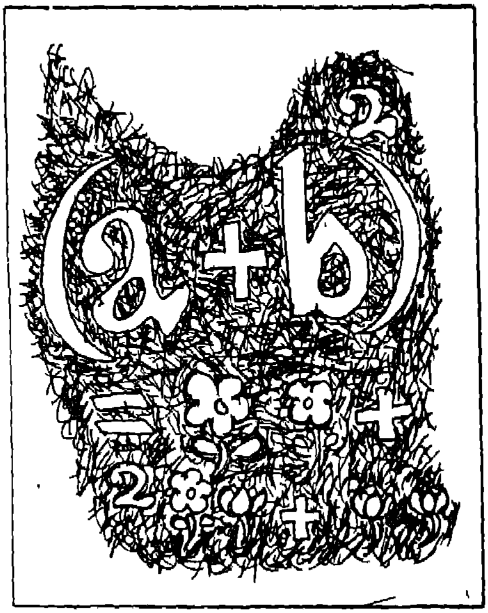
Balanced form of the equation is · ....

Exercise 2 Balance the following equations ....

1. $Al_2(SO_4)_3 + PbCl_2 \rightarrow PbSO_4 + AlCl_3$
2. $Al + O_2 \rightarrow Al_2O_3$
3. $Ba(OH)_2 + HCl \rightarrow BaCl_2 + H_2O$
4. $KBr + Cl_2 \rightarrow KCl + Br_2$
5. $Ca_3(PO_4)_2 + Na \rightarrow Na_3Po_4 + Ca$

Divisibility by Prime Numbers

K.S Khichi
Regional Institute of Education
Ajmer



It has been a matter of interest to ascertain whether a given natural number is completely divisible by a prime number or not. Lot of work has been done in this direction by many people notable among them is Fermat Various divisibility tests have been derived from time to time for academic purposes as well as to create interest among the children to learn mathematics Some of the work done in this direction is by Linder (1), Singh (2), Subramanya (3), Jayshree (4) and the author himself (5) They have separately obtained divisibility tests for some prime numbers.

Sharma (6) has given divisibility rules for prime numbers between 11 and 100 No proof for obtaining this rule was given and he mentioned that the same has been obtained by trial and error. The tests are based on a specific number, different for different prime numbers, and nothing is given about the method to arrive at this number

This paper deals with the proof of divisibility rules for all the 22 prime numbers between 10 and 100. In this paper, formula for obtaining the quotient, without actually dividing the given number by the prime number is also derived

For ascertaining the divisibility of any number of a prime number (say 13), Sharma (6) gives the procedure as : Split the given number into two parts i e. number obtained by removing the unit digit and the unit digit. Multiply the unit digit by 4 and add it to the number obtained by removing the unit digit If this new number is divisible by 13, original number is also divisible by 13 The process can be repeated in case of large number. The reason for selecting this specific number 4 for the prime number 13 is not given

In this paper, the procedure for obtaining this specific number for different prime numbers is given. It is also established that there can be more that one formula for testing the divisibility by a prime number and the one which is most convenient has to be selected for this purpose.

Identification of the Specific Number

Any number can be represented by $10a+b$ where b is the digit at unit place and a is the number obtained by removing unit digit from the given number. Let us take the rule for divisibility by 13 mentioned above. If the given number $10a+b$ divisible by 13 then $4(10a+b)$ is also divisible by 13. Thus we obtain that $39a + (a+4b)$ or $a+4b$ should be divisible by 13. Thus this specific number 4 for the prime number 13 is obtained.

By this way, many other divisibility rules for a prime number can be obtained. For example, on multiplying the number $10a+b$ by 7 or 9 we can say that $10a+b$ is divisible 13 if $5a + 7b$ or $a-9b$ is divisible by 13.

Thus a general rule for obtaining the divisibility condition is given below.

For obtaining the divisibility of a number $10a+b$ by a prime number m, write the multiple of m. If $rm+1 = 10n$ where r and n are whole number then n is the specific number for the prime number m and $10a+b$ is divisible by m if $a + nb$ is divisible by m.

These specific numbers are given in the following table.

TABLE 1

Prime number (m)	Specific number (n)	Prime number (m)	Specific number (n)
11	10	53	16
13	04	59	06
17	02	61	55
19	07	67	47
23	07	71	64
29	03	73	22
31	28	79	08
37	26	83	25
41	37	89	09
43	13	91	82
47	33	97	68

From the above table, it is clear that for checking the divisibility of the number $10a+b$ by 7 we have to check the divisibility of $a+64b$. Since multiplication of b by 64 is lengthy, the rule for difference of a and n'b may be used. Thus for all prime numbers ending with one another rule is formed as 'the number Oa+b is divisible by m if the difference of a and b is divisible by m. 'The specific number n' is given in the following table.

TABLE 2

Prime Number (m)	11	31	41	61	71	91
Specific numbe r(n)	01	03	04	06	07	09

So the number 1547 is divisible by 91 since $9b=9\times7 = 63$, $a=154$ and $154-63 = 91$ is divisible by 91.

By applying the same procedure, the specific number n' for divisibility test of prime numbers ending with 7 is obtained and given in the following table.

TABLE 3

Prime number (m)	17	37	47	67	97
Specific number (n')	05	11	14	20	29

The same procedure can be applied to obtain specific numbers for testing divisibility by more than two digit prime numbers. The same can be easily done by the readers.

To obtain the quotient without actual division

Test of divisibility of any number by a prime number is given earlier. Here a formula for finding out the quotient, without actual division, will be established.

As usual, we write any number as

10a+b and m as a prime number The condition for the divisibility of 10a+b by m is that a+nb should be divisible by m Take $\frac{a+nb}{m} = K$

Where n has the usual meaning.

Formula for obtaining the quotient is given in the following table ·

TABLE 4

Prime Number	*Quotient*	*Prime Number*	*Quotient*
11	a+b - k	53	a+13b-43k
13	a+b-3k	59	a+5b-49k
17	a+5b-7k	61	a+46b - 51k
19	a+b-9k	67	a+40b - 57k
23	a+4b -13k	71	a+55b-61k
29	a+19b-21k	79	a+19b-63k
31	a+19b-21k	83	a+22b-73k
41	a+28b-31k	89	a+8b-79k
43	a+10b-33k	91	a+73b-8k
47	a+26b-37k	97	a+61b-87k

The proof of these expressions for quotient is very simple and can be obtained for each of the prime numbers separately

For example, consider the division of a number 10a+b by the prime number 13 Here $K = \frac{a+4b}{13}$ which is a whole number

The quotient Q is given by

$$Q = \frac{1}{13}\ (10a + b) = \frac{4}{4 \times 13}\ (10a + b)$$

$$= \frac{1}{4}\ (3a + K)$$

$$= a + \frac{k}{4} - \frac{a}{4}$$

$$= a + b - \frac{(a + 4b - K)}{4}$$

$$= a + b - 3k$$

Use of this formula is explained in the following example Take the divisibility of 3562 by 13 As per Table No 1

$$a+4b = 356 + 8 = 364$$

This is divisible by 13 so 3562 is also divisible by 13. The value of K here is ·

$$\frac{364}{13} = 28$$

$$\text{So } \frac{3562}{13} = a+b - 3K = 356 + 2 - 3 \times 28$$

$$= 274$$

It is also observed in Table 4 that the first term of each expression is a and the third term is (m-10) K.

However the middle term does not have any common pattern. But there exists a pattern for each set of prime numbers ending with 1,3,7 and 9. For example, the middle term for division by

$$13\ \ b + \frac{(m - 13)}{10}\ \ 3b$$ where m is the prime number ending with the digit 3

Similarly, the middle terms for the expressions of quotient for prime numbers ending with 1,5 and 7 can be obtained as

$$b + \frac{(m - 11)}{10}\ \ 9b,\ 5b + \frac{(m - 17)}{10}\ \ 7b$$ an

$$b + \frac{(m - 19)}{10}\ \ b$$ respectively

Another table for obtaining the quotient, based on Tables 2 and 3, i e. using the condition of difference of two numbers, can also be obtained for prime numbers ending with digits 1 and 7 so as to make the calculations easy and at times orally also

The procedure described above can be used to find out the divisibility rules and accordingly the quotients for 3 for more digit prime numbers

REFERENCES

1 Linden, Andrew, Divisibility by 7; *Mathematics Teaching*, No.68, Sept. '74

2 Singh, Pritam, Fun with mathematics, *Science Today*, Jan., '81.

3 Subramanya, N , Divisibility of some peculiar numbers *The Mathematics Education*, Vol XV, No.1, March 81

4 Jayshree, S , Divisibility test by 7,11 and 3,*School Science*, Vol XXVII, No 1 March '90

5 Khichi, K S., Some interesting divisibility properties of peculiar numbers *The Mathematics Education*, Vol XIX No 1 March '85

6 Sharma, Shiv Nath, Divisibility rules for prime numbers,*Vigyan Pragati*, June, July '83.

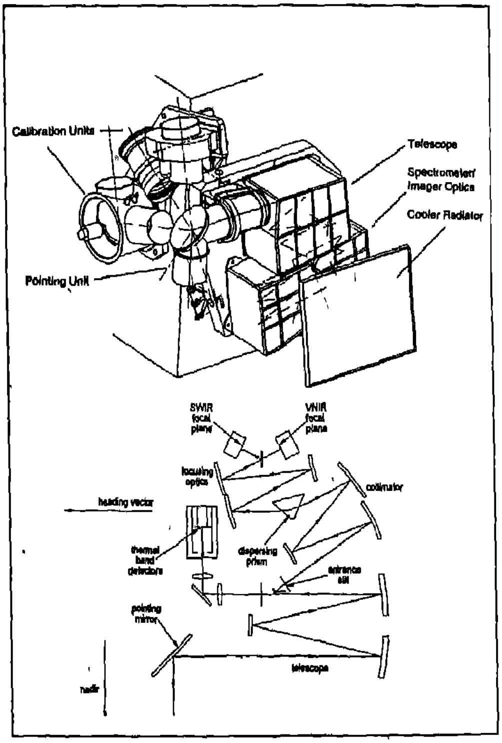
Science Feature

Skywatch on the 21st Century

Rodney Steel
LPS Special Correspondent

As concern grows about the future ecological well-being of the Earth, demand is growing for ever more powerful and discriminating observation satellites to monitor our threatened natural environment. At Chislehurst, 20 km from London, the electro-optical specialist company, Sira, is designing ultrasensitive instrumentation for a 21st century European satellite that would enable scientists to monitor such significant occurrences as global warming, ozone depletion, pollution levels throughout the biosphere, the health of crops, the spread or retreat of deserts, and the changing patterns of the world's weather.

The ESA (European Space Agency) requirement is for an imaging spectroradiometre sensitive to wavelengths from 450 nanometres (the deep blue end of the visible spectrum) to 2.35 micrometres (short-wave infra-red), as well as two bands in the thermal infra-red region, and possessing a resolution of 50 m on the ground from a 775 km high polar orbit. An especially demanding aspect of the specification is a need



Projected layout of the PRISM imaging spectroradiometre (above), with a basic optical layout (below).
SWIR : short-wave infra-red;
VNIR : visible and near infra-red

for the instrument to be capable of not only viewing vertically downwards but also out to a distance of 400 km on either side and possibly also 700 km forward along its track and 400 km backward at terrain it has just passed over

Known as Process Research by an Imaging Space Mission (PRISM), this European project has attracted competitive bids from several aerospace consortia. Sira is partnered on the instrument package design with Dornier Satellite Systems, Matra-Marconi Space and another UK participant, AEA Technology (advising on calibration and tribology), under an overall Daimler-Benz umbrella

The specification that Sira has to meet is for an instrument which will gather spectral radiance data for the study of land processes in the visible, near infra-red and short-wave infra-red bands, as well as registering surface temperatures in the thermal infra-red. The spatial resolution of 50 m on the ground which is demanded must be accompanied by a typical image size of 50 km by 50 k, the radiance ranges must encompass normal land brightness and temperature ranges, and accuracy within 2 per cent for spectral imaging and one degree for temperature readings

Target Selection

The requirement for an instrument that possesses pointing capabilities for target selection and directional reflectance measurements poses a major design challenge to the scientists at Sira. The across-track pointing range is typically to be plus or minus 35 degrees, while along the track the range angle is set at plus or minus 56 degrees (with an angle of plus minus 70 degrees on the ground)

The instrument now taking shape in concept is an imaging spectroradiometre, comprising a pointing unit directed at the earth, that feeds the collected light via a telescope to the collimator with its dispersing prism, and on to focusing optics which separate out the short-wave infra-red from visible light and near infra-red, registering them at separate focal planes. Thermal infra-red emissions are directed straight to special thermal band detectors after passing through the telescope

To achieve the high spectral resolution required, complex 1000-element detectors will be needed, silicon charge-coupled devices being planned for the visible and near infra-red wave bands, while cadmium-mercury telluride units are a likely choice for both short-wave infra-red and thermal infra-red A cooling radiator to ensure against overheating of the instruments from solar radiation will be mounted on the shaded side of the satellite, which maintains a constant orientation with regard to the sun.

No Illusions

Top Sira scientist Mr Dan Lobb has no illusions about the difficulties of the task facing his Chislehurst-based team

"The first challenge is the two-axis pointing capability, although that may be solved by rotation of the whole satellite," he said. "If it isn't, it comes back to us to devise a separate mirror system This is an all-new requirement. It's not something that other instruments have done. I think this is probably the first time anybody has tried to do this for an Earth-observing instrument"

The PRISM satellite is planned to circle the Earth in a polar orbit, taking

100 minutes for each complete circumnavigation while beneath it every area of the continents and oceans is surveyed at three-day intervals

Continuous comprehensive surveillance of this nature by Sira's sensitive imaging spectro-radiometre, with its outstanding resolution qualities, offers huge prospective returns in terms of data. PRISM's non-stop, automatically up-dated status report on the Earth's physical well-being would enable agronomists to see at a glance which areas of the world are growing healthy crops, and where low plant water content or other adverse conditions could lead to famine

Meteorologists could check on demystifications, ice-field movements, or surface radiation reflectance (albedo) to determine prospective changes in weather patterns, including the periodic catastrophic El Nino disturbances that so severely affect the countries bordering the southern Pacific. For earth scientists, there will be data to aid in geological mapping, leading perhaps to mineral discoveries, a better understanding of irrigation problems, or more effective compromises between conservation and the demands of agriculture

PRISM will be able to constantly monitor the composition of the atmosphere · how much water vapour is present, what percentages of trace gases occur, and very significantly whether ozone depletion is occuring over the poles (with a polar orbit, PRISM would be an ideal instrument to check on this growing hazard to life on our planet Earth)

Pollution of waterways and coastal regions, and the notorious' red blooms' of algae that it causes, will be permanently under surveillance. Receptors recording the thermal infra-red bands will tell scientists what the temperatures are on the land surface, on the cloud tops, and in the surface waters of the oceans, so that any degree of overall climatic warming can be constantly checked and regional temperature augmentation detected.

The PRISM project could be an outstanding contribution to the practical employment of space science in the 21st century Such projects are never cheap, but as environmental problems become ever more pressing and the demands of modern societies grow increasingly urgent, exacerbated by population growth that in some areas is still explosive, satellite surveillance like that offered by PRISM is becoming more and more essential

Courtesy . Spectrum

Science News

Watch out for Hale-Bopp Comet

Discovered in July 1995 by Allen Hale and Thomas Bopp, amateur astronomers of the U S , the Hale-Bopp Comet will be visible to the naked eye in March and April, 1997.

The Comet was visible in the direction of the 13th Zodiacal sign of a Ophicuous in November, 1996 At that time it could be observed only through to telescope and had developed a prominent tail

It will be the brightest comet of the century The comet is approaching the Sun at a velocity of 1 million km a day Having circled the Sun, the comet will spend its next 15,000 years in deep space. At the time of its discovery the comet was at a distance of 750 million km from the sun

At its closest to the Sun, the comet will be about 10 million km away. Its tail at that time in expected to grow about 12 million km long.

Scientists are keenly awaiting for the arrival of the comet. The elements present in the comet are the main focus of these investigations Astronomers would use optical, infra-red, X-ray and ultra-violet telescope to study the nucleus of the comet Scientists are interested in finding out whether the comet has any trace of elements that constitute basic building blocks for life on the earth such as amino-acids, water or ammonia.

Hale-Bopp comet will be visible along with the total solar eclipse over Mongolian Siberia on March 9, 1997 The comet will be visible close to the cornea of the eclipsed Sun.

Respiratory Problems can be Genetic

Children with persistent respiratory problems should be screened for cystic fibrosis (cf) of a potentially fatal genetic disorder, say researchers at the All India Institute of Medical Science (AIIMS), New Delhi

CF affects the lungs. The disease which is the most common genetic disorder in the West was hitherto considered to be very rare among Asians But studies at the AIIMS Paediatric Department have exploded this myth.

"Our findings confirm that CF occurs in India and its should be suspected in all children with persistent respiratory problems", said Dr. Ishwar Verma and his colleagues in a report published in the Indian Journal of Medical Research.

A test for this inherited disease has now become available at the AIIMS

The disease is caused by defects or "mutations" in a specific gene first discovered in 1989 The scientists at AIIMS said this particular mutation was detected in six out of 13 cases (46%) of CF diagnosed at AIIMS between June 1992 December 1995

Artificial Respiration made Easier

The advances in medical technologies have now made artificial respiration possible, without inserting a tube into the wind pipe of the patient

The latest technique, which is offered only at a few hospitals, is known as "Non-Invasive Positive Pressure Ventilation", and can even be administered to a patient while still at home.

The procedure was demonstrated to doctors from all parts of the country at the National Conference on Acute Respiratory Care being organized by the Delhi Medical Association and Delhi Chest Forum at the Indraprastha Apollo Hospital, New Delhi

It is envisaged that this technique would come as a boon for patients suffering from chronic bronchitis and emphysema Earlier, these patients had to be put on an invasive artificial respiration with a tube in the wind pipe and it was difficult to wean them away from this machine

With the new technique, it has not only become easy for the doctor to withdraw this support, but it also makes life easier for the patients as they can eat as well as talk while on the therapy Previously, 50% of the patients died before they could be taken off the invasive respiration

Atlantis Docks with Mir, Brings Back Record-Setting Astronaut

The space shuttle Atlantis returned to Earth on September 26, 1996 with astronaut Shannon Lucid who spent 188 days in orbit aboard the Russian Mir space station, setting an endurance record for a woman in space

Atlantis touched down at the Kennedy Space Center in Florida to wrap up a 10-day mission that included a linkup with the Russian station—the fourth in a series of linkups to pave the way for construction of an international space station due to be completed in mid-1998. The docking missions are intended to give U S astronauts experience with long-duration spaceflight, carry out joint scientific research, and test hardware and procedures to reduce risks associated with operations aboard the international space stations.

Atlantis and its six crew members were launched on September 16 1996 and over the next two days, with periodic firings of the spacecraft's small thruster engines, gradually moved closer to Mir. The two spacecraft docked late September 18 to pick up Lucid and drop off astronaut John Blaha', who will spend four months aboard the station Blaha, a retired Air Force colonel, is the third American to live aboard Mir. The first was astronaut Norman Thagard, who spent 115 days aboard the station last year

Lucid's six-month stay aboard the

Russian complex set a world record for female astronauts and a U S. record for all space fliers Her stay was two months longer than Thagard's pioneering visit to Mir

The 53-year-old biochemist was supposed to return to Earth in mid-August after a four-month mission to Mir, but the Atlantis flight was delayed for six weeks to replace the shuttle's twin booster rockets after minor heat damage was discovered in identical boosters used to launch the shuttle Columbia last June. That and bad weather left Lucid in orbit an extra seven weeks.

Russian cosmonaut Yelena Kondakova's 169-day Mir mission had previously been the longest spaceflight by a woman. Cosmonaut Valery Polyakov holds the world record with his 438-day Mir flight that ended last year.

Several hundred people gathered at Kennedy to welcome Lucid home, including her husband and three grown children

Daniel Goldin, administrator of the National Aeronautics and Space Administration (NASA), presented Lucid with a present from President Clinton · a huge box of candy called M&Ms Lucid had said she craved the candy while living abroad Mir

Goldin, who called Lucid his hero, said, "She has a toughness and she has an ability to perform She stuck with it...and this is what's so good about her".

President Clinton phoned Lucid soon after her arrival to welcome her back home "We're all so proud of you", he told her Lucid replied that she was "just really proud to be an American, and I'm just really proud to be part of this cooperative program that we have going with the Russians. It was just a great mission. And I just had a great time"

The President told her he appreciated what she said "about the cooperation with Russia It really sets the stage for the work on the international space station And it's very, very important And I believe the way you captured the public imagination will also help us to build longterm support for the space program"

NASA doctors are eager to examine Lucid after her long exposure to weightlessness Astronauts can lose up to a quarter of their strength while in orbit because in zero gravity there's little need to use muscles

During their five days of linked flight, the crews moved about 2,000 kilograms of food, water and other resupply items along with research hardware and equipment from Atlantis to Mir and 990 kilograms of U.S , Russian and European Space Agency scientific samples and equipment to the shuttle

Atlantis also carried a new high volume research module provided by Spacehab, Incorporated The so called double module was made up of two normal Spacehab chambers bolted together and connected to the crew cabin by a pressurized tunnel

The forward portion of the double module housed experiments to be conducted by the crew before, during and after Atlantis docked with Mir. The aft portion of the module housed the supplies to be transferred to the space station

One of the experiments carried aboard Spacehab was a new high-temperature furnace capable of melting iron The furnace, which may be carried aboard the planned international space station, will be used to study how flaws form in cast metals and allow metallurgists to make stronger machine tools on Earth

An experiment aboard Mir involved videotaping crew members playing darts to study how they adapted to zero gravity In another Mir experiment, researchers collected data by means of instrumented footloops and handholds to determine the forces that astronauts exert on spaceships. Currently engineers must over-design racks housing sensitive experiments that could be disturbed by the movements of astronauts.

The shuttle undocked from Mir on September 23 as the two spacecraft flew some 380 kilometers over the Ural Mountains, between Russia and Kazakhstan Atlantis then flew around Mir twice at a distance of about 122 meters, allowing the astronauts to take pictures of the station, which has had new parts added since the last shuttle visit in March

"I'm really happy and I also feel just a little sad", said Lucid, as the two spacecraft separated "This has been my home for six months, and I've had a great time here But obviously I'm very, very anxious to go back to my real home...with my family"

Mir commander Valery Korzun said· "Not only are we saying goodbye to a colleague, but to a very fine person". Russian space officials said Lucid never complained once during her long space mission aboard Mir "She's an outstanding person", said General Yuri Glazkov, deputy commander of Russia's cosmonaut training centre "Everybody loves her"

Blaha is scheduled to spend four months on Mir, sharing the station with cosmonauts Korzun and Alexander Kaleri. Both arrived on the orbiting station last month to replace two other cosmonauts who occupied Mir during Lucid's first five months on Mir.

The fifth Mir-docking mission is planned for January. Atlantis will bring up astronaut Jerry Linenger, who will switch places with Blaha.

COURTESY · *Science Update*

Swansea Scientists Delve Deeper into Molecules

Techniques pioneered by the University of Wales at Swansea, are providing increased capabilities across a wide range of uses including research into the nature of diseases at their earliest stages and the detection of sophisticated sports cheats who try to mask the use of drugs.

Equipment includes sensitive mass spectrometers that can weigh an individual molecule extremely accurately to produce a highly detailed 'fingerprint' of its spectrum enabling scientists to detect ultra-low levels of substances

The work of the research unit is assisting many industrial clients around the world Its staff focuses both on fundamental research to increase knowledge of mass spectrometry and associated techniques, and on applications for their science

These uses include characterisation of biomolecules, pharmaceutical and agrochemical products and analysis of food, petrochemical products and drugs in biological materials

The unit also specialises in the design and construction of ultra-high resolution fittings for translational energy loss spectrometers such as the unit in the picture, the most powerful of its kind in the world

Renowned internationally, the research unit runs courses on aspects of mass spectrometry for industrial and scientific users in Britain and other countries Students studying at the unit at present include young people from China, India, Malaysia, Portugal and Spain — specialists who will go on to apply the wide-ranging work of the pioneering Swansea scientists to benefit the world's products and people far into the next century.

Courtesy *Spectrum*

Breakthrough in Cancer Research

It is now possible to design special proteins that can recognize and switch off cancer genes to arrest cancerous growth according to Sir Aaron Klug who won the Nobel Prize in Chemistry in 1982 for his work in Crystallography.

According to Sir Aaron practical application of the new find has still a long way to go yet it has proved the point that one can design proteins that can manipulate genes.

Sir Aaron's team at the Medical Research Centre laboratory of molecular biology in Cambridge discovered a natural protein that they named, zinc fingers (the protein contains zinc and has finger-like loops on the surface) that can bind with the Deoxyribose Nucleic Acid (DNA) in a gene.

The zinc fingers protein could recognize a gene that is responsible for a type of leukaemia called All

All is triggered during a genetic abnormality — the DNA of one end of chromosome number 22 gets interchanged with that of chromosome 9 (there are 23 pairs of chromosomes in a human cell). This combination produces a new class of DNA, a cancer-causing gene or Oncogene that cannot be controlled

The team selected a natural zinc finger protein that can bind with the Oncogene and inhibit its activity The protein was simply punched into a laboratory cell line containing the Oncogene, where it stopped the cancer gene from expressing itself.

"Although it is a crude delivery system, with only 30% efficiency, it proved the basic point that such proteins can be introduced to switch Oncogenes off", Sir Aaron said

But, scientists need a perfect delivery system for the scheme to work in cancer cells on experimental animals, he added

The work also shows that one can begin to manipulate DNA both inside and outside a cell using such proteins "Other families of proteins similar to the zinc finger family may be around the corner" Sir Aaron

"Breakthrough" Hailed in Polio Vaccine for Developing Nations

A private company working with United Nations and U S agencies and nonprofit organizations had developed what is being hailed as a breakthrough in the campaign to eradicate polio in developing countries

The World Health Assembly, convened by the United Nations in 1988, set a goal of eradicating polio by the year 2000 That has already been accomplished in North, Central and South America, Atwood said

The technical development provides an easy way for health workers in developing countries to assess whether bottled polio vaccine is still potent

Polio vaccine in vials from which drops are placed in a youngster's mouth is effective for months if stored at temperatures of minus 20 Celsius or below Oral polio vaccine can be ruined in just days if subjected to some of the high temperatures found in tropical areas. Proper refrigeration in developing countries, particularly in rural areas, is often not available.

Therefore, health care workers often cannot know whether the vials are still good They then have to decide whether to take a chance and use them or throw them away

A U S. has developed a "marker" that could be pasted to the bottle of polio vaccine The marker is sensitive to time and temperature and when a square gets as dark in color as its surrounding circle on the marker, the vaccine should not be used because its effectiveness has been destroyed

WHO reports that the number of new polio cases fell to 6,179 in 1995, 28 percent below the number in 1994 and 82 percent less than in 1988, when the eradication goal was created. Thirty countries reported more than 10 cases in 1995, 27 less than 10 and 150 none at all.

Nelle Temple Brown, a spokeswoman for WHO, said at the briefing that probably 10 times more cases occur than is reported One reason for the undereporting is that the disease now strikes in the more remote areas of developing countries, she said

Most of the polio cases in 1995 came in Southeast Asia Of the 3,398 reported there, India accounted for 3,142 India staged "national immunization days" in December 1995 and January 1996, when 92 million children over the age of five were given the oral vaccine. Millions of children upto 5 years age were again given oral polio drops through national immunization drive organized on December 17, 1996 and January 7, 1997

Africa was the area with the second highest number of polio cases in 1995—1,512

COURTESY *Science Update*

Galileo Images of Jupiter Moon result in New Discoveries

The first close-up photographs of Jupiter's moon Ganymede show that the surface of the giant satellite appears to be wrinkled and torn by geologic forces like those that make mountains and move continents on Earth.

The new images, which are toppling theories about the planet-sized moon, were taken by cameras aboard the unmanned spacecraft Galileo during its flyby Ganymede, Galileo passed within just 726 kilometers of the big moon, 70 times closer than the Voyager flyby missions in 1979 The latest pictures were sent back to Earth over the two week period following the flyby

"These images have exceeded our

wildest expectations", said Michael Belton, a researcher at the National Optical Astronomy Observatories and head of Galileo's imaging team

"We knew Ganymede was an interesting place, but what we have just found makes it even more exciting", said Torrence Johnson, Galileo project scientist at the National Aeronautics and Space Administration's Jet Propulsion Laboratory in Pasadena, California, where the images were released

Ganymede, one of Jupiter's four huge satellites, is larger than the planet Mercury and three-quarters the size of Mars It is the largest moon in the solar system. The Galileo spacecraft, launched in 1989 aboard the space shuttle, began orbiting Jupiter in December, 1995

The new close-up images indicate that Ganymede's surface, made up of approximately equal proportions of rock and ice, is far more geologically active than previously thought They show that the moon's surface has been extensively bombed by comets and asteroids, but has been resurfaced is some areas by more recent volcanic eruptions, quakes and other tectonic activity

During the flyby, Galileo's cameras focused on a ridged area called Uruk Sulcus and another area called Galileo Regio Johnson said the image of Uruk Sulcus shows "the surface is tremendously cut up by faults" The same forces that work on the rock of Earth's crust are working on the half-rock, half-ice composition of Ganymede's surface, he added.

Both areas show ancient cratered ice fields adjacent to or overlain by younger icy volcanic plains, ridged ice mountains, deep furrows and smooth broad basins that are products of tectonic forces Scientists believe Ganymede's ridges, icy grooves and craters may indicate an Earth-like crust that pulls apart and fills in with flowing rock

Other scientific instruments aboard Galileo discovered that Ganymede possesses its own magnetosphere, a region of highly charged particles that surrounds many planets but has never been found to exist around a moon before.

The finding indicates that the planet-sized Ganymede very likely creates its own magnetic field The possible sources of the magnetic field include a molten iron core or even a thin layer of conducting salty water or hot hidden oceans flowing underneath the moon's icy crust

"We are as puzzled as anyone by the question of what could produce this magnetic field", said researcher Margaret Kivelson of the University of California at Los Angeles

"While we expected some degree of interaction between Ganymede and Jupiter's magnetic environment, the size and the effect (of the magnetosphere) at Ganymede were completely unexpected", Johnson said.

Galileo's plasma wave spectrometer, an instrument that measures variations in electromagnetic waves in Jupiter's environment, showed that the densities of charged particles around Ganymede increased by a factor of more than 100 near Galileo's closest approach

"This indicates that Ganymede is surrounded by a thin ionosphere", said Donald Gurnett, a researcher at the University of Iowa and principal investigator for the spectrometer experiment "The existence of an ionosphere suggests that Ganymede also probably has a tenuous atmosphere"

Galileo is scheduled to make three more close flybys of Ganymede during its two-year mission in orbit around Jupiter

Future flybys will permit observations of other regions of Ganymede's surface and further studies of the moon's magnetosphere

COURTESY : *Science Update*

Micro Electronics Help Restore Some Mobility to the Paralysed

A surgeon at the Spinal Treatment Centre at Salisbury District Hospital, Wiltshire, western England, implanted a prototype of a micro-electronic device, developed at University College, London, into Ms Julie Hill, who suffered a fracture of her spinal cord in a car accident, leaving her paralysed

Standing for even a few minutes a day helps to reduce the danger of pressure sores and bladder infections in people with injuries like these

Developed by two researchers, honorary senior research fellow, Dr Nicholas Donaldson, and Tim Perkins, the equipment can be implanted into patients to stimulate nerves in their backs below the point of injury.

"From our previous experience of stimulating nerves to give people control over their bladders, we realised that there was great potential to tackle the problem by stimulating the nerves that control leg muscles, especially at the roots where the nerves leave the spinal cord", says Dr Donaldson.

The device consists of a receiver placed under the skin next to the ribs and wires that feed around to the back to electrodes that lie on six pairs of nerve roots Power and appropriate signals are fed to the stimulator using radio frequency induction.

Ms. Julie Hill has been undergoing tests once a week during which the nerves in her back are electronically stimulated and the effect this has on the leg muscles is recorded Her performance has improved over time as she recovered from the surgery and her muscles grew in strength

The bioengineers and physiotherapists are currently studying variations in her performance They will continue their series of implantations and hope to develop the device so that it can give greater control over the legs and the bladder. Dr Donaldson hopes that further development and wider clinical testing at other spinal injury centres will be only a few years away.

COURTESY : *Spectrum*

Diamonds Synthesized in Space

The National Space Development Agency (NASDA) of Japan has succeeded in synthesizing a thin-film diamond in the microgravity environment, marking the world's first successful Chemical Vapour Deposition of diamond

The thin-film diamond is attracting attention as a promising electronics material due to its outstanding intrinsic properties

The experiment, conducted in a microgravity environment free of thermal convection, is expected to yield fruit-ful results not only for the ground research into this material, but also for the efforts to advance further material experiment technologies in outer space

The experiment was performed aboard the Space Flyer Unit (SFU) launched by NASDA's H-II rocket flight number 3 in March, 1995

It was retrieved by the US space shuttle with Japanese astronaut, Wakata, operating the onboard manipulator

The SFU remained in a 480-km orbit for about six months and conducted over 20 experiments It took about five hours to synthesize on thin-film diamond.

The primary assessment of the recovered thin-film diamond, conducted by modal observation with scanning electron microscope, confirmed its morphological growth under the microgravity environment ,

The synthesis of diamond in space was also proved by the Raman Spectroscopic Analysis.

Low-fat Diet could be Suicidal

Latest studies suggest that a low-fat diet may drive people to suicide According to these studies, low cholesterol levels may be good for the heart but bad for psychic to the content that it may increase the risk of depression.

However, other experts feel that these suggestions are still not proved beyond doubt

In one of these studies, more than 6,000 men in their forties and early fifties had their cholesterol measured and were followed for 17 years It was found that 32 had committed suicide The risk of suicide for those with low cholesterol was more than three times that of others, after taking account of other differences, according to researchers at the National Institute of Health and Medical Research in Paris

However, an accompanying editorial by S Lori Brown, senior scientist at the Centre for Devices and Radiological Health in the USA, says those who committed suicide may have been iller to begin with "Men who are ill may be depressed and this may have influenced their appetite and hence cholesterol levels"

In a second study, by researchers from Vienna, 20 pregnant women had their cholesterol measured before and after birth, because of the known sudden fall in the levels after delivery The results showed that those with the sharpest fall in cholesterol were most depressed

A second commentary, by Malcolm Law, of the Wolfson Institute of Preventive Medicine in London, says that 13 trials of cholesterol-lowering drugs had shown no increase in depression among those taking them. The debate about a possible link between cholesterol and suicide had been overwhelmed by 'irrelevant' evidence.

Genetic due to High Blood Pressure

The discovery that a rare genetic defect causes high blood pressure could result in better treatment for thousands of sufferers.

Dr Paul Stewart and colleagues from

the Department of Medicine at Birmingham University in the English Midlands found the defective gene in two young brothers who had a rare form of high blood pressure. Their parents were healthy, but were first cousins and the boys had inherited one copy of the gene from each.

The gene normally makes an enzyme that converts the stress, hormone cortisol into inactive cortisone The children lack this enzyme and the excess cortisol interferes with the uptake of another adrenal hormone, aldosterone. Aldosterone is important in controlling salt levels and therefore blood pressure, and by blocking a normal blood pressure control route the cortisol causes high blood pressure.

Dr Stewart says although the gene defect is very rare, he believes it could be much more widely relevant to the problem of high blood pressure He explained : "Up to a third of people with high blood pressure have some evidence of inappropriate salt retention Although they won't have a full-blown defect, it could be that much more sure abnormalities produce an enzyme that is firing on two cylinders rather than four".

The Birmingham team is now looking at high blood pressure sufferers to see if they are converting cortisol to cortisone normally Its work could result in new drugs but Dr Stewart says they may not be necessary. He continues· "Even with the drugs we have got, in many cases of hypertension we could do a much better job if we knew what the underlying defect was"

COURTESY : *Spectrum*

Making Sure the Eye does not Lie

Automated recognition of people by the pattern of the iris in the eye offers major advantages over conventional identification techniques. The random and highly complex patterns in the structure of irises are even more individual than fingerprints and these features lend themselves more readily to rapid checking against a computer database.

Dr John G Daugman at Cambridge University has developed computer algorithms that enable the unique features of an iris to be encoded in as little as 256 bytes, which enables the identity of an individual to be established, verified or denied, by comparing it with reference to iris patterns, at a rate of 40,000 persons a second using ordinary computer equipment. Simple dedicated hardware can speed up this search to 160 million people a second, believes Dr. Daugman.

One of the first commercial applications of Dr Daugman's technology is to identify users of ATMs (automatic teller or cash dispensing machines) through the use of a built-in 'smart' camera now being developed by Sensar of the USA for Oki, Japan's largest manufacturer of ATMs.

The complex mathematics needed to encode and compress the large quantity of digital data contained in the image of an iris into a small data-storage volume—while enabling the presented image to be compared to a reference image with extremely low error rates (said to be many hundreds of times less than other bioelectric identification systems)—is at the heart of the technology.

The structure of an iris remains stable over decades The system also detects the small variations such as constriction and dilation of the pupil, which are characteristic of a living eye, so that it cannot be deceived by, for instance, presenting a take eye or photograph.

Licences are also currently being negotiated for car anti-theft devices, and for use of the iris pattern as an encryption key for securing telecommunications over non-secure channels

COURTESY · *Spectrum*

Fossil of 'Oldest' Bird on Display

What scientists claim to be the world's first bird was displayed to the public for the first time in Beijing during an exhibition held in January 1997 The feathered animal is believed to be the ancestor of all the birds.

The fossil was found in Liaoning province by a fossil-hunter, Li Yumin He took it to the Geology Museum in Beijing believing it to be a dragon The museum, determined that the fossil was that of a bird and the oldest ever found.

The Chinese have given the fossil the name Sinosauropteryx Prima. In appearance it is closer to a land-based dinosaur, but it has a number of characteristics that prove the evolutionary link with birds.

According to the experts "The forelegs show a definite tendency to developing towards wings". The key factor, however, was the discovery of feathery imprints in the fossil

"Without the indication of primitive feathers, it would have been hard to say for certain whether the animal was a bird or just a small dinosaur", said the experts. It is believed that Sinosauropteryx was probably unable to fly, despite possessing feathers, primitive wings and other bird-like features. It is speculated that it ran on its hind legs rather like an ostrich.

The role of the earliest bird has long been taken by Archaeopteryx-lithographica, which flourished about 150 million years ago. Though not an agile flyer, it was certainly capable of flight If the role of Sinosauropteryx is confirmed, it will represent an earlier stage in avian development when reptiles first developed wings

But some scientists still disagree with the idea, insisting that it was merely a "warm-blooded dinosaur with feather"

Ornithologists believe birds evolved from reptile-like dinosaurs during the Triassic period, more than 250 million years ago.

Life on Mars Possible

Life may have existed on mars billions of years ago and could still be there today, claim British scientists based on new evidence unearthed by them

British scientists from the open university and the natural history museum have confirmed that a second meteorite from the red planet contains significant amounts of organic material, the statement added

The scientists also found tiny amounts of carbonate in the original Martian meteorite with a geological signature suggesting it was formed from methane — a gas often produced by micro-organisms

Planetary Cooling Reverses Warm Weather Trend

According to the Britain's Meteorological Office, the warming trend that began in the early 1980s was reversed in 1996 with a sharp cooling of the planet.

The dip in temperature was due to a phenomenon known as the North Atlantic oscillation which has flipped for the first time in 10 to 15 years.

During most years, there is low pressure over Iceland and a high over the Azores in the winter months. It means that westerly winds dominate blowing over the British Isles and into northern Europe and Russia

But in 1996 there was a 'flip' similar to the famous freezing winter of 1963, with a high between Scotland and Iceland and low in the Azores leading to easterly winds sweeping in from Siberia and the Arctic.

These led to freezing Siberian winds blasting most of Canada and northern Europe, including Britain over Christmas and during the early part of the year.

The year 1996 has been 0 2 to 0.15 degree C cooler than 1995, the hottest year on record, and 1990, the second hottest year on record A climate phenomenon, called El Nino, also halted — making the tropics slightly cooler too.

However, scientists warn that it does not mean the underlying trend of global warming is over and overall the world's temperature in 1996 will be between 0.6 and 0.8 degrees C higher than in the 1860s when records began

Since the early 1980s the world has steadily warmed The dust cloud caused by the eruption of Mount Pinatubo, in the Philippines, in June 1991, partly slowed down the warming trend.

Intelligent Cat's Eyes' Warn drivers of Hazards

Intelligent 'cat's eyes' which detect and communicate hazardous road conditions to drivers by emitting a series of differently coloured light beams, have been developed by scientists at a British company

The Intelligent Road Stud (IRS), from Astucial Ltd has a built-in microprocessor and sensors that detect different weather conditions and the speed of passing traffic. It is powered by a rechargeable solar cell and a tiny internal battery

When the unit detects a hazard, such as fog, it emits a flashing white light which is projected towards oncoming vehicles This provides drivers with a clear outline of the road, ahead, unlike traditional 'cat's eyes' which are at their least effective in fog.

Similarly, if temperatures drop and there is a possibility of ice forming, the IRS will emit a flashing blue light, and continue to do so until the ice melts Heavy rain, which brings the possibility of aquaplaning on surface water, also triggers a blue light

In all hazardous conditions the IRS leaves a trial of orange flashing lights behind passing vehicles, indicating the approximate stopping distances to following vehicles If a driver gets too close to a vehicle in front, the lights turn red.

The units can be set inside existing road stud housings, or alternatively mounted on posts and New Jersey Barrier, and operate in a temperature range of 40°C to +85°C The company claims that the solar rechargeable units will operate for several weeks on a single charge, replenishing their energy during daytime (even on overcast days) and at night from vehicle headlight beams. A maximum operational life of 10 years is also claimed

Each of the features is available as a single-function unit—or any combination of features may be specified. In its simplest form the unit could be installed as a night flasher device, delineating the road far beyond car headlight beams The company has also developed infrared - and RF-communicating models for installation in tunnels, airports and other locations requiring centrally controlled switchable lane markers.

The product is being installed on five kilometers of a highway in a mountainous region of Canada, infamous for dense fog

COURTESY · *Spectrum*

New Surfacing brings Instant Repairs to Roads and Runway

Permanent repairs to roads and airport runways can be made instantly using a material developed by a specialist British company. The surfacing can be used in conditions ranging from very dry to very wet and from +40° to –40°C The manufacturer claims that within seconds of application, it will be possible to drive heavy vehicles or to land aircraft on the repaired surface

The material Emcol IRR, can be used for cost effective repairs to asphalt, macadam, concrete and other surfaces It abuts well to metal and composite materials and is not subject to shrinkage, stripping or liquid/aggregate separation The material, which consists of a combination of selected aggregates and a binder liquid based on penetration bitumens, resins, adhesives and other additives, is applied cold without the use of hot-laid asphalt

Emcol IRR is also widely used for infilling cable ducts, trenches, core holes, access-cover surround and drains, ramping, concrete-slab-corner repairs and for jointing Packed in 25 kg resaleable buckets, the product has a storage life of 10 months and is cold applied straight from the pack It needs no track coats, overbanding or special equipment

Were Some Dinosaurs Cold Blooded ?

A group of scientists has claimed to have found the first fossilized evidence that some dinosaurs were coldblooded

But several experts are of the opinion that the research did not close the debate over whether dinosaurs were coldblood or warmblooded and the question might never be fully answered.

Researchers have found that the computed axial tomography — or cat scans — of "superbly preserved specimens" of cretaceous dinosaurs show nasal anatomy similar to that of coldblooded modern animals such as crocodiles and other lizards.

The scanned specimens included a tyrannosaurus rexlike dinosaur; a velociraptor, or biped type; an ostrich type, and a duckbilled type, all of which lived toward the end of the dinosaurs' era

The cat scans showed that the dinosaurs had narrow, tubelike nasal passages with no trace of respiratory turbinates, spiral structures that in such warm-blooded animals as birds and mammals increase the surface area of their nasal passages

Respiratory turbinates reduce the otherwise sharply accelerated rates of evaporative heat and water loss that would come with high breathing rates . Their absence indicates, that the dinosaurs' breathing and metabolic rates were low enough to keep evaporative heat and water loss from being a problem.

Research on dinosaurs' metabolisms — which would hold clues to their feeding, reproductive and overall living habits — has been hampered because most information was contained in soft tissue, which did not fossilize

Some experts familiar with the study said they remained doubtful that the lack of respiratory turbinates was solid evidence of metabolic rates or that the fossils could adequately show an absence of turbinates

Honey Bees to Monitor Toxic Chemicals in the Atmosphere

Services of thousands of honey bees are being utilized in a unique manner to detect traces of escaping chemical weapons at one of the most toxic dump sites in the USA.

According to Mr Jerry J Bromenshenk, a University of Montana Biologist who designed the project for the military base "honey bees do so by buzzing from flower to flower, gathering nectar and pollen and particles of everything else they happen to touch"

A report published recently reveals that every move of the honey bees engaged in minority is spied continuously. It includes continuing their comings and goings, sniffing them, even gauging the amount of wind generated by their wings.

According to Mr Jerry honey bee is probably nature's most superb monitor of materials. He describes them as flying dust mops in air, with their electrostatically charged hairs.

In earlier projects, the bees from the hives near contaminated sites were periodically removed to study the content of the dust sticking to their bodies.

The project conceived now is more sophisticated, with 14 beehives enclosed in wooden boxes shaped like two-drawer filing cabinets that are loaded with high-tech instruments. Infra-red beams record the comings and goings of each hive's 10, 000 residents. The hives are constantly weighed, while other devices measure and chart their temperature and humidity

Researchers periodically draw air from the hives through tubes loaded with carbon filters that trap volatile chemicals.

Book Review

Numerical Problems in Physics

By B L Dhar, published by Sultan Chand & Sons, New Delhi, 1996 (Tenth revised edition).

This book is written for +2 students who intend to prepare for entrance tests conducted by various agencies for admission to Engineering and Medical Courses with difficulty level of problems set in such tests going up and with the gap between the difficulty levels of problems set in such tests and the those set in Board's papers, such books have made their own place and utility This book contains 28 chapters detailing problems and their solutions on various topics in physics Definitions of relevant formulae, symbols and concepts have been given at the beginning of each chapter Different types of problems have been included under each topic and a good number of these problems are adopted from old question papers Fully solved question papers of IITEE '91, '92, '93, '94 and Roorkee EE '91 are included as Appendices towards the end of the book Appendix VIII gives an additional set of objective type questions and their answers.

Though the book presents a good collection of problems on all topics relevant to +2 physics, the chapters are not ordered properly content-wise For example, Kinetic theory of gases and Thermodynamics are covered in Chapter 10 and 11 respectively but Heat is discussed in Chapter 25. Similarly, Optics is included at Chapter 14 ,but Light is included at Chapter 26· These two chapters should be better merged into one chapter. Further, Electrostatics is taken up in Chapter 28 while Electricity (I) and Electricity (II) are discussed in Chapter 15 and 16

A number of printing mistakes have also crept in. For example, on page 1 7 in Eq.(1) T^2 should be printed as T^{-2} Similarly, on p 5 10, last line should read as 6 4×10^6 A better proof reading will possibly eliminate the printing mistakes The pages in this book are not numbered in a way convenient to readers In fact, it would be a good exercise for students to find the total number of pages in this book

Though SI units and standard symbols are used throughout the book, standard symbols have not been used consistently For example, for second 's' should be used but at many places, sec is used (see, e g , Ex 22 p 2 15)

But taken in totality, the author has done a good job in collecting the problems and presenting their solutions and this book will serve as a good sourcebook for students who intend to prepare for admission test to various Medical / Engineering Courses

V.P Srivastava
Department of Education in
Science and Mathematics
NCERT, New Delhi

FORM IV

(See Rule 8)

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I, R.S. Saxena, hereby declare that the particulars given above are true to the best of my knowledge and belief

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We request our contributors to follow the guidelines given below while sending their contributions so that uniformity and consistency could be maintained in the presentation

- Manuscripts should be exclusive to the *Journal of Indian Education*. A certificate to this effect should be enclosed along with the manuscripts
- Contributions should be in English, typed (double-spaced) on one side of A4 size bond paper with generous margins and not exceeding 15 pages in case of articles and 18 pages in case of studies
- Contributions should be sent in duplicate The first copy should essentially be the original typescript whereas the second copy may be xeroxed or carbon copied
- Contributions should be clear in content and consistent in style.
- An abstract of the article/paper in not more than 120 words should be sent with each manuscript
- Acronyms should be expanded at their first appearance as per the sample given below.

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  SEN GUPTA, M. 1976 **Personality Characteristics of Creative Engineers: A Review of Researches. *Journal of Indian Education*** 3. pp 26-33.

SCIENCE RELATED VALUES

Curiosity, quest for knowledge, objectivity, honesty and truthfulness, courage to question, systematic reasoning, acceptance after proof/verification, open-mindedness, search for perfection and team spirit are some of the basic values related to science. The processes of science, which help in searching the truth about nature and its phenomena are characterised by these values. Science aims at explaining things and events. Therefore to learn and practise science :

- **Be inquisitive about things and events around you.**
- **Have the courage to question beliefs and practices.**
- **Ask 'what', 'how' and 'why' and find your answers by critically observing, experimenting, consulting, discussing and reasoning.**
- **Record honestly your observations and experimental results in your laboratory or outside it.**
- **Repeat experiments carefully and systematically if required, but do not manipulate your results under any circumstance.**
- **Be guided by facts, reasons and logic. Do not be biased in one way or the other.**
- **Aspire to make new discoveries and inventions by sustained and dedicated work.**

SCHOOL SCIENCE is a journal published quarterly by the National Council of Educational Research and Training, New Delhi. It aims at bringing within easy reach of teachers and students the recent developments in science and science methodology, and serves as a useful forum for the exchange of readers' views and experiences in science education and science projects.

Articles suitable to the objectives mentioned above are invited for publication. An article sent for publication should normally not exceed ten typed pages, and it should be *exclusive* to this journal. Illustrations should be drawn with pen and indelible Indian ink. Photographs (black and white), at least of postcard size, should be on glossy paper, and should be properly packed to avoid damage in transit.

Manuscripts with illustrations, charts, graphs, etc. along with legends, neatly typed in double space on uniformly sized paper, should be sent to the Executive Editor, SCHOOL SCIENCE, Department of Education in Science and Mathematics, NCERT, Sri Aurobindo Marg, New Delhi 110 016

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TO OUR CONTRIBUTORS

SCHOOL SCIENCE *invites articles from teachers, acquainting students with recent developments in science and science methodology. The articles should be addressed to the Executive Editor, Department of Education in Science and Mathematics, NCERT, Sri Aurobindo Marg, New Delhi 110 016*

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iction and Motion

P SRIVASTAVA
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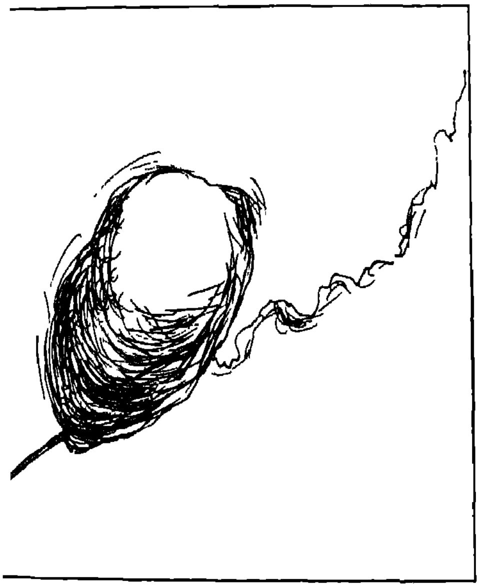


Friction and motion are inseparable from each other Wherever there is motion, forces of iction arise in some form or the other riction forces play an important role n our environment In almost all me- hanical phenomena, there arises force of friction whose action as a rule is associated with a transformation of one form of energy into another. Most often, under the action of friction the mechanical energy is transformed into heat So far as their action is concerned forces of friction do not differ from other types of forces such as force of gravity, or deformation, but their nature possesses some specific features Using Newton's laws of motion, we can discuss the variation of velocity/acceleration of a body with time under the action of an applied force and the friction force Though the role of friction forces in motion is well understood, the nature of friction is not Still there is no microscopic theory which provides complete explanation of different types of friction and a basis of calculating these forces for a given pair of surfaces under various conditions. In this article we will discuss about different types of friction their possible origins and finally their role in determining the nature of motion of an object

Let us consider two examples In the first example, let us consider a body lying on a table Suppose we try to push it along the horizontal surface by gradually increasing an applied force When the applied force **P** is not sufficiently large, the body remains at rest But from Newton's first law of motion this means that the table acts on the body with a force whose magnitude is equal to that of **P** while its direction is opposite It is the force **F** (= – **P**) that results from the friction between the body and the table The force of the gravity on the body and the reaction force of the table on it are vertical and in opposite directions; they balance each other and so do not affect the magnitude of the horizontal force When we increase or decrease the applied force, the friction force also varies accordingly Second example, if we slide a book on the surface of a table, the motion of the book undergoes a deceleration and the book will finally come to rest. Thus the velocity of the book decreases and the direction of its acceleration is opposite to that of the velocity. The deceleration of the book is caused by the forces of friction exerted on it by the table

The physical characters of the friction forces in the above two examples are quite different In the first example, the friction force is due to the action of external force P and in this case we speak of the force of friction of rest or of **static friction.** As we increase the magnitude of the lateral force, the force of static friction also increases linearly as shown in Fig 2(a) until the body (mass m) begins to slide The magnitude of the maximum possible friction force, f_0, is observed to be directly proportional to the reaction force N (= m g) of the table, i e

$$f_0 = \mu_s N \qquad (1)$$

where μ_s is called the coefficient of static friction. Its value depends upon the materials that are in contact and the nature of the surfaces of the materials It takes less force to overcome the, frictional forces between a piece of ice and a wood surface than those that exist when a block of wood surface than those that exist when a block of wood having the same weight is put in its place In the phenomenon of static friction there is no motion of bodies and therefore no work is performed, that is, no energy is converted from one form to the other

In the second case, the friction force is due to the relative motion of one body over the other and is known as **kineti friction** or **sliding friction** Here too the force of friction is opposite to the direction of motion and its magnitude is once again proportional to that of the normal reaction force N and we have

$$f_k = \mu_k N \qquad .. (2$$

Where μ_k is the coefficient of kineti friction. It is experimentally found that the force of kinetic friction that acts when a body slides along a supporting surface is almost **invariably less** than the maximum static friction force the same interface can support This implies that for a given interface μ_k is always less than μ_s The force of kinetic friction varies with the applied force as shown in Fig 2(a) Further, the action of the force of kinetic friction involves work and in such cases there is transformation of kinetic energy into heat.

Equation (2) embodies a simple empirical law about friction first enunciated by Leonardo da Vinci (1452-1519) This law was rediscovered by Amonton in 1699 and verified by Coulomb i 1781, who was the first to distinguis clearly between static and dynamic friction The law states that *the magnitud of the friction force between unlubricate dry surfaces sliding one over the oth is proportional to the normal force actı on the surfaces and is independent the area of contact and of the relati speed.* It should be noted that the direction of the two forces are, howev quite different· the normal force N i perpendicular to the surface of the contact; whereas the friction force f_k

parallel to this surface, in a direction opposite to that of the motion. But the "law" of friction lacks the general validity of, say Newton's laws and is only approximately valid. It merely describes the results of empirical observations and is not based on any detailed theoretical understanding of the mechanism that causes friction. Deviations from this simple law occur at high speeds and low speeds. However, we can ignore these deviations in many everyday problems. The simple law is then a reasonably good approximation for a wide range of materials, and it is at its best for metals.

A few representative values of coefficients of friction are given in Table 1. The friction coefficients depend on the condition of the surfaces. The values in the table are typical for dry surfaces but not entirely reliable. The friction coefficient depends on the conditions of the surfaces. In general, the coefficients of friction of nonmetals are lower than those of the metals, with diamond, corundum and sapphires giving very low values of the order of 0.04 - 0.10. The frictional coefficients of plastics and polymers depend on their structure and vary from as low as 0.05 to 1.5, which is the value for most metals.

TABLE 1. **A few representative values of coefficients of friction**

Surface	μ_s	μ_k
Copper on steel	0.53	0.36
Copper on cast iron	1.05	0.29
Rubber on concrete	0.90	0.80
Wood on leather	0.50	0.40
Steel on ice	0.10	0.06
Ice on ice	0.05-0.15	0.02
Steel on steel	0.74	0.57
Glass on glass	0.94	0.40

The friction between dry surfaces of rigid bodies is sometimes also known as **dry friction** and static and dynamic frictions are its two kinds. A third heading under which dry friction is sometimes classified, in addition to static and dynamic friction, is **rolling friction** which arises during rolling motion of a body. But the coefficient of rolling friction is in general very small in comparison with the other two coefficients. For example, whereas the coefficient of friction for steel sliding on steel is of the order of 0.2, the corresponding quantity for a steel ball rolling on steel is only about 0.002. It is because of the extreme smallness of rolling friction that ball and roller bearings are extensively used in machinery. There is second type of friction known as **viscous friction.** This type of friction arises when a body moves in a fluid or gas. But there is one important distinction in the two types of friction. While in the case of dry friction there may arise a force of static friction (friction of rest), in the case of viscous friction the force of static friction does not appear — in fact it is zero. The forces of viscous friction appear only during the course of motion and their action is always associated with the transformation of the mechanical energy into heat.

Static friction, on the whole, is useful and it is difficult to imagine what life would be like without it. The possibility of making string, rope and fabrics of all kinds depends on static friction, the strength and durability of the materials depending on the friction between the fibres. But for friction, knots would come undone — indeed, it would not even be possible to tie them in the first place! The action of belts, pulleys, and friction drives in machinery depends on static friction. Finally, but for static friction we should not be able to walk, or to start, stop, or change the direction of wheeled vehicles

Kinetic friction, on the other hand, is generally a nuisance For example, it is responsible for the "dissipation" of energy (conversion of other forms into heat) in machinery and for its eventual wearing out. Among the few items on the credit side are the action of the clutch of an automobile (during starting) and the action of brakes.

Friction also arises in relative motion of bones at joints in our body. But nature has provided a special fluid known as synovial fluid in joints which reduces the friction considerably The end of each bone is covered by a layer of cartilage. Each joint is enclosed by a membrane, and the cavity is filled with synovial liquid. The cartilage acts as a sponge for synovial fluid. At a joint the bones are in contact over a small area, and this presses the synovial fluid out of the cartilage to provide weeping lubrication This yields a very small coefficient of friction of about 0 003 and thereby facilitates easy motion of bones at the joints

Origin of Dry Friction

Till date we do not have a microscopic theory which provides a thorough explanation of friction of dry surfaces But it is believed that the major cause of this type of friction is the microscopic roughness of the surfaces in contact We present a rough scheme of the phenomena giving rise to the forces of dry friction Figure 1 shows an enlarged normal section of the contacting surfaces of two solids In reality, the surface of a body cannot be perfectly smooth, it always consists of a series of hills and valleys which, although not apparent to the naked eye, are large enough on a molecular scale. For example, a metal surface finely tuned in a lathe will have hills about 5 μm (5 x 10^{-6}m) high, but these can be reduced to about 0.1 μm by carefully lapping with fine grade of polishing materials. Such asperities are still large on a molecular scale, so that even when two highly polished surfaces come into contact, they do so only at high points (points such as a, b, and c in Fig 1) In fact, the true area of contact may be a factor of 10^4 less than the apparent value Since the contact area maybe very small, the pressure at these points is very large indeed. In most cases such a high pressure is sufficient to deform the surfaces at the points of contact plastically so that the contact area becomes larger. At the same time, adhesion or welding will occur at the high spots because the two surfaces are so close together at such points that the unsatisfied surface bonds can become interconnected

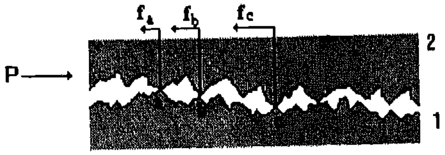


Fig 1

In the state of rest, when the forces of static friction arise, that is when $P < f_0$, the horizontal tangential components of the interaction forces between the protrusions of the bodies, "create" the force of friction that exactly balances the external force. Let us consider the situation shown in Fig. 1 When an external force P is applied to body 2 tangential forces f_a, f_b, and f_c arise in the region adjoining the points a, b, and c. The resultant of these forces is in balance with the external force (In the figure, the vectors representing the forces f_a, f_b and f_c are depicted above the bodies for the sake of visuality in reality, the direction of the forces lie in the plane of the interface between the two bodies)

When $P > f_0$, that is when the bodies are in relative motion, the forces of adhesion or cohesion also arises due to close proximity of the irregularities in the surfaces of the two bodies In addition, these irregularities strike each other so that the result of the cohesion and impact forces give rise to the friction force resisting the mutual sliding of the surfaces of the two bodies The impact forces between the protrusions produce their oscillations which propagate in various directions in the contacting bodies It is plausible that the inelastic deformation accompanying the impact of the protrusions and irregularities of the contacting bodies also play an important role in this phenomenon

Dry Friction : From Rest to Motion

Now we will discuss the role of forces of dry friction as we push a body from the state of rest to the state of motion For this we consider a block of mass m resting on a horizontal plane surface and subjected to an applied lateral force P as shown in Fig 2(a). Experimentally, it is found that the friction force f varies with the lateral force P as shown in Fig. 2(b) At the point of impending motion the force of static friction reaches a maximum value equal to $\mu_s N = \mu_s mg$ As the block starts sliding, the force of friction suddenly reduces to a lower value equal to the kinetic friction force $f_k = \mu_k N$ (Note that $\mu_k < \mu_s$ as discussed above)

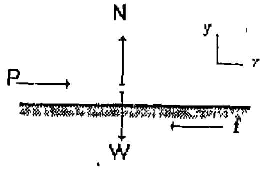


Fig 2(a)

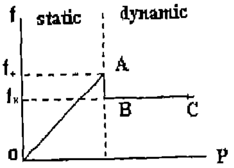


Fig 2(b)

Let us now consider the behaviour of the block under different applied forces.

Block at rest and impending motion

When the applied force P is not large enough, i e , $P < f_0$ the block is in static equilibrium in the x-direction and we have

$\Sigma F = 0$ or $P - f = 0$ (3)

or $P = f < f_0$ (4)

At point a, the friction force f reaches a maximum value equal to $f_0 = \mu_s N$. At this stage, motion is impending but the block is still in static equilibrium

$\Sigma F = 0$ $P - f_0 = 0$

or $P = f_0$ (5)

Beginning of motion

If we now increase the force beyond $P = f_0$, the block starts moving. The friction force in action now is due to kinetic friction and given by $f_k = \mu_k N$. Since $\mu_k < \mu_s$, the block suddenly shifts from point A on the static curve to point B on the dynamic curve. If the applied force continues to be equal to f_0, the block experiences an unbalanced force $(P - f_k)$ and an acceleration equal to $(P - f_k)/m$ acts on the body. Now the equation of motion is

$\Sigma f = ma$ or $P - f_k = m\,a$

Because of the acceleration, the block gains velocity. After the block has been set in motion and has gained some velocity, the motion depends on the variation of the applied force P with time. We discuss the following simple cases

If the applied force is kept simple constant at the value $P = f_0$ that was required to set the block in motion, the unbalanced force remains constant. The result is that the block is accelerated at a constant rate and its velocity increases linearly with time (Fig. 3a)

Suppose the applied force is increased linearly with time. Then the unbalanced force also increases linearly and the velocity changes with time as shown in Fig. 3b

If, at some time T_1, the applied force is reduced to a value $P = f_k$, the unbalanced force $P - f_k = 0$ and the acceleration of the block reduces to zero. The block moves with constant velocity (Fig. 3c)

Finally suppose after some time T_2, the applied force is removed, i.e., $P = 0$ then $P - f_k = -f_k$ and the acceleration is negative. The velocity of the block decreases and it comes to rest. (Fig. 3d).

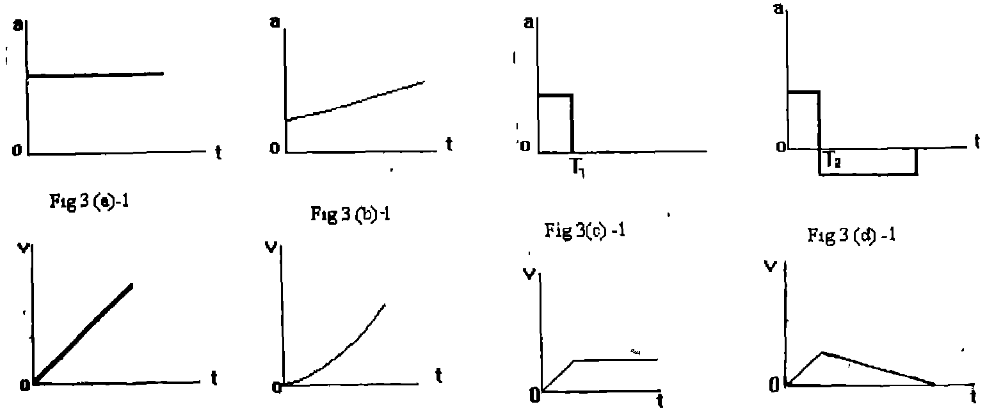


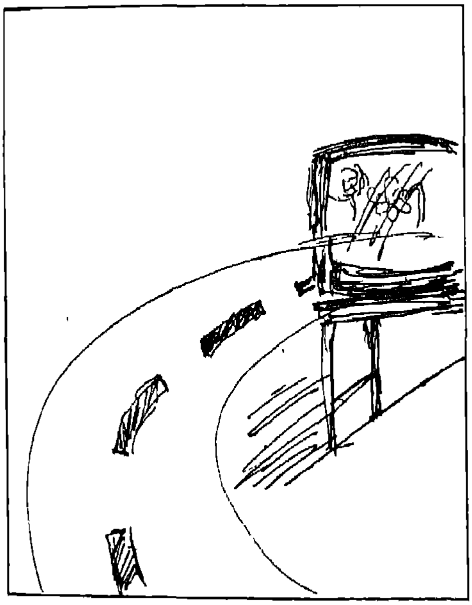
Fig 3 (a)-1 Fig 3 (b)-1 Fig 3(c) -1 Fig 3 (d) -1

Fig 3 (a)-2 Fig 3 (b) -2 Fig 3(c)-2 Fig 3(d) -2

Fig 3. Acceleration and velocity versus time after the motion is set

The World Brought to Our Drawing Room

K V GOPALAKRISHNAN
Professor
Department of Mechanical Engineering
Indian Institute of Technology, Madras



Few inventions in History have drawn the extremes of praise and condemnation that television (TV) has It is hailed as a great educational medium by many; reviled by an equally large number as the spreader of violence and mental laziness (the "idiot box") But none denies its effectiveness and power The impact of visual presentation on the mass is profound indeed In its short existence the television has practically destroyed may long-standing art forms, created new ones and led to the rise or fall of many powerful political figures

If we stand back and ponder for a moment what television does is truly miraculous A cricket match played half a world away in the West Indies is displayed instantly in India The horrors of a battle field, the emotion-surcharged atmosphere of a riot or demonstration, the scenic grandeur of the Antarctica or the Himalayas, are all brought effortlessly into our own living rooms When Neil Amstrong took the first human step on the moon, hundreds of millions watched him spellbound on their TV sets.

Even within the few decades since its inception television has profoundly affected the world. Political campaigns in developed nations are now carried out through TV and not through public meetings The course of the Vietnam War was decisively influenced by television People everywhere have become more aware of the cultures and attitudes of far away nations and this has helped to draw the world together. No manufacturer worth his name foregoes the advantage of TV advertising The hunger of people everywhere for more consumer goods and a higher standard of living has been fuelled by these advertisements, It is no longer easy for governments to hide inconvenient facts or events from their people since they can learn about them through the broadcasts of foreign nations through satellite TV All this has been to the good

The deleterious effects of TV are however not negligible either and have invited score and strong opposition from its critics. The main thrust of their argument is that TV has become a channel for vulgar entertainment and violence The growing climate of violence in society is blamed, at least partly, on the influence that TV exerts on young, impressionable minds Another charge is that it prevents the vigorous exercise of mental faculties by its all- absorbing effect There is a growing clamour for control of its programmes.

There is a lot of truth in these criticisms But the answer to the defects of TV is not censorship, which historical experience proves is self-defeating In the course of time, after its novelty gradually wears off, innate human common sense will reassert itself and no amount of high pressure advocacy can make people believe that wrong is right An example is the gradual decrease in cigarette smoking in Western nations inspite of all the millions of dollars its producers spend on advertising and sponsorship It is also to be noted that government controlled TVs command poor credibility with the people, even in countries where they enjoy near monopoly.

Television was anticipated for a long time but took several decades to come to fruition. Once wireless messages could be propagated by electromagnetic waves at the speed of light the next logical step was to think of picture transmission. The first significant step was taken by the German inventor Paul Niplow in 1884. He used a mechanical scanning device, consisting of a light source, a spinning disc with spirally distributed holes and photo electric cells to break up an image into bits and re-assemble them by a reverse process. It worked, but was crude and the picture quality very poor. The next important step was the invention of the cathode ray tube by another German, Ferdin and Braun in 1897 Prof Boris Rosing of Russia then combined this tube with Niplow's system to produce the first true television pictures in 1911 An enthusiastic pioneer of television development in the following decades was Logie Baird of Britain. But the most crucial step was taken by Philo T Farnsworth of the U S A who rejected mechanical scanning systems and developed the first electronic scanning system in 1930 With the principal technical hurdles thus cleared, development of TV proceeded rapidly thereafter Colour TV was also developed using three basic colours, red, green and blue.

In the post Second World War period (after 1945), television broadcasting rapidly spread over Western Europe and North America and subsequently over the rest of the world. The use of geostationary satellites to pick up and re-broadcast TV programmes increased its reach immensely The limitation imposed by the curvature of the earth was thereby overcome (TV signals, unlike radio waves, are not reflected back to the earth by any atmospheric layer). Today practically no country in the world remains uncovered by Television.

Figure 1 shows the basic layout of a colour TV transmission and receiving system. The light from the object is focussed by the lens (1) of the TV camera on colour selective mirrors, which reflect red, green and blue images on the three tubes (2) These tubes convert the optical images into electrical signals which are scanned by an electronic beam Unit (3) combines the signal to form a black and white signal Unit (4) mixes this signal with a colouring signal. Unit (5) is the transmitter, which through a tall mast (6) broadcasts the final signal.

At the receiving end, unit (7) decodes the signals into separate blue, green and red signals Unit (8) generates electron beams of varying intensity to produce the required amount of red, green and blue light at each point on the screen. Deflector coils, make the three electron beams scan the screen, both top to bottom and side to side A shadow mask ensures that each colour beam reaches the corresponding stripes of phosphor coated on the screen. A composite colour picture then emerges

With electronic components becoming smaller and more reliable with time, the future is likely to see large but thin TV sets which can be hung on a wall like a picture, pocket size TVs and so on

Even the most sagacious prophets of today can not predict what the ultimate effects of the revolution launched by the TV will be They are gradually unfolding before our eyes. But certain it is that the world will never be the same again; so profound and powerful has been the impact of this latest and greatest revolution in communications

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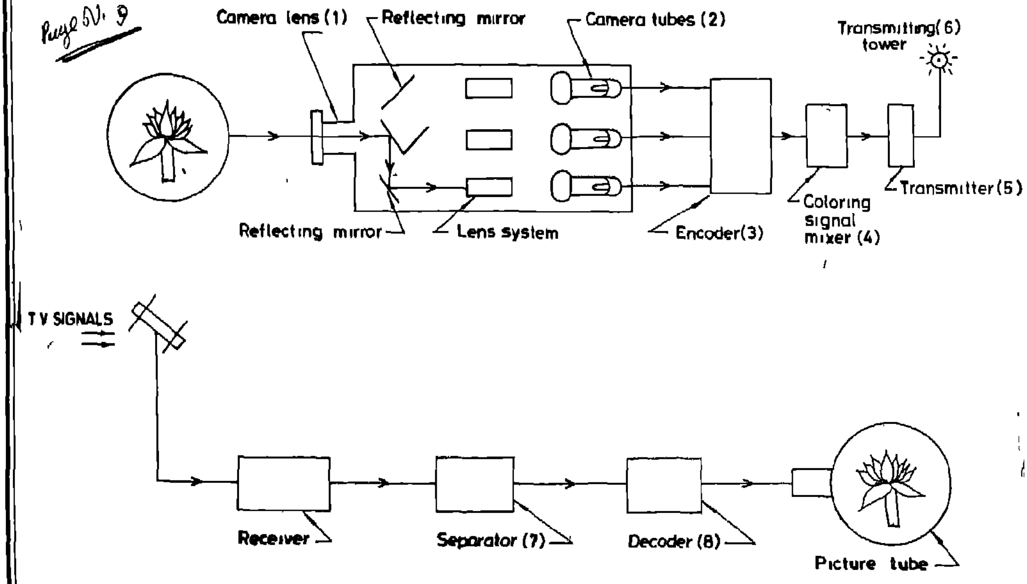
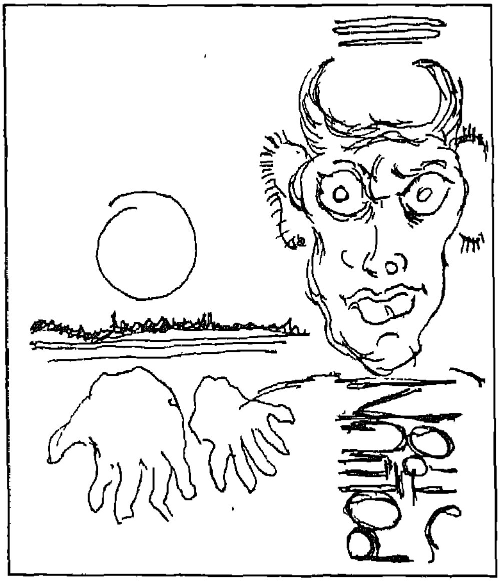


Fig 1. **Main features of a colour television transmission**

Heavy Metal Pollution – What is it ?*

M CHANDRA
Professor
Department of Education in Science and Mathematics
National Council of Educational Research and Training, New Delhi 110 016



The term "heavy metals" is somewhat imprecise The term includes most metals and metalloids with atomic number greater than 20, but excludes alkali metals, the alkaline earth metals, the lanthanides and the actinides (1) The term is commonly adopted as a group name for the metals (and metalloids) which are associated with pollution and toxicity, although heavy metals also include elements such as iron, copper, manganese, selenium, zinc etc., which at low concentrations are essential for living organisms "Toxic metals" is a term suggested as an alternative to the term heavy metals but the term toxic metals could be applicable only to the non-essential elements such as lead, cadmium, mercury, arsenic etc , but not to those biologically essential elements as mentioned earlier "In place of the heavy metal" the term "trace metals" is gaining popularity, but is yet to attain common usage (2) Thus, for our purpose we shall use the more widely recognised term· heavy metal (in elemental or combined form irrespective of whether the element is a metal or a metalloid).

Heavy metals are continually released to the environment by natural processes, such as geological activities, volcanic eruptions, weathering of rocks etc. They may also get added to the environment as soluble materials, chemically weathered from soil and rocks due to geochemical alternations. For millennia, living beings have collectively and individually managed to cope with this natural discharge of heavy metals to their environment

Environmental pollution caused by the addition of heavy metals to the ecosystem due to anthropogenic causes (i e. caused by human activities) began with the domestication of fire itself. The deposition of small amounts of heavy metals, released during burning of fire wood, altered the metal levels in the cave environment With the discovery of mining and metal working techniques, a link between metals, metal pollution and the human environment was formed. Though the ancient mines were operated in small scales, but uncontrolled smelting of large quantities of ores in open fires resulted in substantial emission of heavy metals to the atmosphere.

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* This is the first article of a series of three articles on 'Heavy Metal Pollution' The other articles of the series will be published in subsequent issues

The "Industrial Revolution" brought about unprecedented demand for metals and since then the human race has been extracting enormous quantities of these metals from natural resources, utilizing them In the process at least some portion of these materials are discharged into the environment This process, alongwith greater urbanisation, increase vehicular traffic, use of modern agricultural practices, have ultimately started interfering with the nature's own processes (3). Heavy metals as pollutants of the ecosystem have however, received increasing attention only in the recent years, partly because of the growing scientific and public awareness of the environmental issues

Studies of effect of heavy metals in the ecosystem have indicated that many areas near urban settlements, near mining areas or near major road systems contain anomalously high concentration of these elements. In fact, we may be experiencing "silent epidemic" of environmental poisoning from the ever increasing amounts of metal wastes on the ecosystem However, on the one hand we are faced with the danger of heavy metal pollution while on the other agricultural lands in many parts of the world have been found to be deficient in one or more micronutrients — also heavy metals (or metalloids) such as, copper, manganese, zinc, cobalt, chromium, selenium etc. (4)

How do Heavy Metals Reach the Ecosystem ?

The ultimate sink for heavy metals (and for many toxic organic compounds) is their deposition and burial in soils, sediments and water bodies Heavy metals often accumulate in the top layer of the soil and are, therefore, accessible for uptake by roots and crops The organic matter which gives the soils a dark colour, is primarily a material called humus, and is derived principally as decay product of photosynthetic plants Humic materials have great affinity for heavy metal cations and extract them from the water that passes through them The binding of heavy metal cations occurs largely because of complex formation with the heavy metal ion by - COOH group present in the humus However, apart from this process of complexation by humic substances, heavy metals are also retained by the soil and water through two other processes: (1) adsorption on to the surface of mineral particles in soil and organic particles suspended in water, and (ii) precipitation reactions.

When in water, the particles with adsorbed heavy metals eventually settle to the bottom of the water body and become buried when other sediments accumulate on top of them. The "burial" represents an important sink for many pollutants However, since adsorption and desorption establish an equilibrium, the freshly deposited matter can re-contaminate the water above it. The adsorbed pollutants enter the food web, if the particles are consumed by organisms that grow at the bottom of water bodies (5) Heavy metals which are selectively concentrated by vegetation may also find their way to surface water following decay and run off They are also added to the water system from individual sources, especially those devoted to mining, cleaning and plating of metals Poor disposal methods prac-

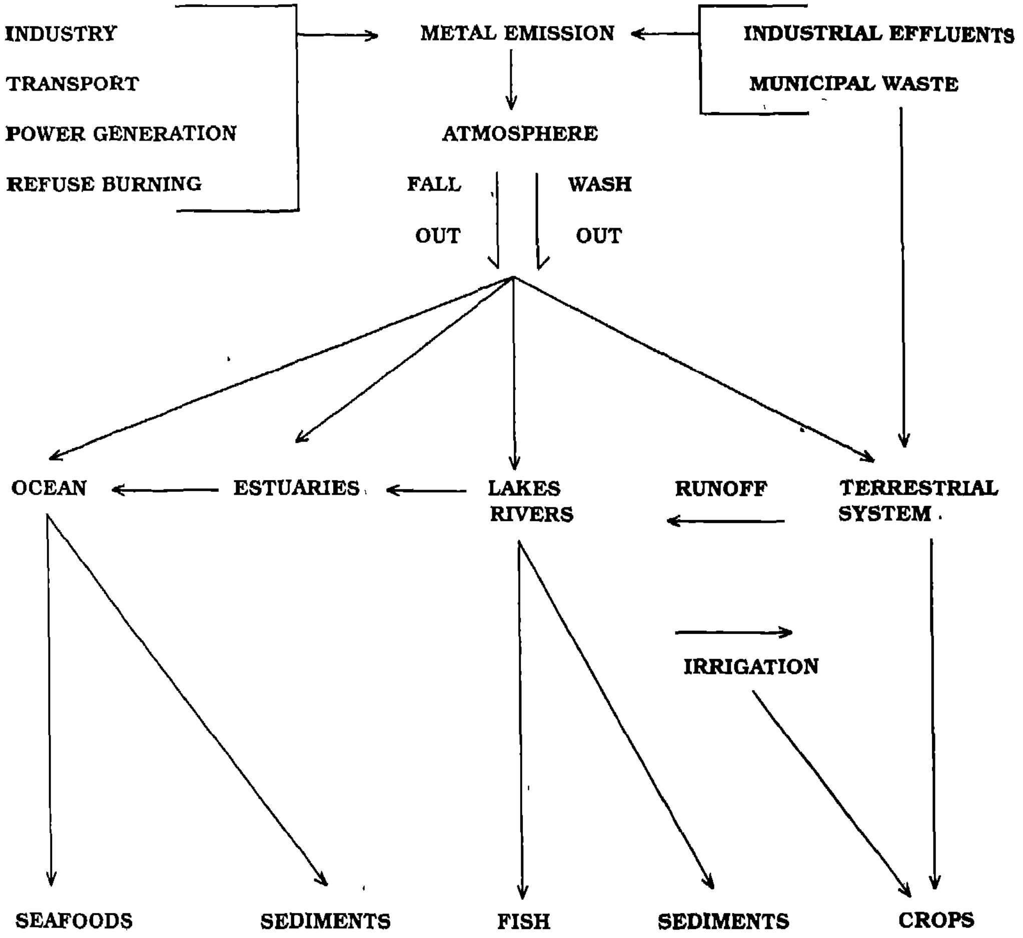


Fig 1. **Anthropogenic Dispersion of Metals in Environment**

Source : Chandra (S V.) Toxic Metals in Environment (1980) 66pp.

used by the industries which use heavy metals, also leads to the problem of contamination of the natural ecosystems (6) However, apart from being present in water and in soil, heavy metals can also get transported from place to place via air, usually in the form of adsorbed or suspended particulate matter (7) (Fig 1).

Toxicity of Heavy Metals

From the point of view of toxicity towards health of living beings, heavy metals can be divided into four major groups:

(i) essential to life processes, copper, zinc, chromium, manganese, tin, cobalt, Molybdenum, scandium, nickel vanadium;

(ii) not essential to life process. zirconium;

(iii) toxic to life process: tin and arsenic;

(iv) highly toxic to life processes: mercury, cadmium, lead

However, it is difficult to make a clear distinction between essential and toxic metallic elements (and metalloids) because all metals (and metalloids) are probably toxic if ingested in sufficiently large doses (8).

The symptoms of the toxic effects of the heavy metals may vary widely at the physiological level, but the basic mechanisms of toxicity at the molecular level are limited. The toxicity of the heavy metals are found to be caused through one or more of the following mechanisms:

(i) Biochemically, the mechanism of the toxic action of the heavy metals arises from the strong affinity that they have for sulphur Thus, the sulphydryl group-SH which occurs commonly in the enzymes that control the speed of critical metabolic reactions in human body, readily attach themselves to the ingested heavy metal The resultant heavy metal-sulphur bonding blocks the active site of the enzyme, thus preventing it from functioning normally This adversely affects the living beings, sometimes even fatally As in a familiar reaction of hydrogen sulphide (H_2S) with heavy metal species to produce (MS) (represented as). H-S-H+M → MS + $2H^+$ (M^{2+} being the heavy metal ion) The sulphydryl units of enzyme R-S-H produce stable systems such as R-S-M-S-R with M^{2+}

$$R - S - H + M^{2+}H - S - R \rightarrow$$
$$R - S - M - S - R + 2H^{+} \qquad (9)$$

(ii) A heavy metal ion may also be able to displace essential metal ion from biomolecules

Thus a heavy metal ion may displace an essential ion if its affinity to the binding site is stronger than that of the "native" ion Biomolecules produced in this process, with "foreign" metal ions, often loose capability to carry their normal activity

(iii) Modification of the active conformation of the biomolecules, especially in enzymes, making them nonfunctionary, is another way in which heavy metals cause harm to living beings.

(iv) A heavy metal ion may bind itself with the negatively charged head(s) of phospholipids and thus lead to toxicity One of the toxic effects of Pb (ii), is considered to be its ability to bind itself to PO^{3-}_{4} of proteins

(v) Heavy metals in some cases, are also found to be effective in blocking some enzymes, which degrade the toxins produced by bacteria· Cd (ii), Pb(ii) being two such examples.

(vi) Pb(II) is found to replace Ca(II) in bone material, resulting in reduction of the mechanical strength of the bones (10).

The toxicity of the heavy metals also depends much on the chemical form of the element, i e. upon the **speciation**. Forms which are almost totally insoluble pass through the living body without doing much harm. The most devastating forms of the heavy metals are those that cause immediate sickness or death. In these cases the time available for therapy cannot exert its effects in time. Apart from this type, for human beings, those forms of heavy metals that can pass through the membrane that protects the brain, the brain-blood barrier or that which protects the developing foetus, can cause alarming results. For some heavy metals like mercury the form that is most toxic is the one having an alkyl group attached to the metal This is because many such compounds are soluble in animal tissues and can pass through biological membranes (11). When in an aquatic system, environmental factors viz, change in· dissolved oxygen, pH, temperature and nutrient content of water may modify the acute toxic effects of these heavy metal pollutants (12)

Evidence exists that the biological effects of heavy metals are strongly influenced by their oxidation states and the way in which they are combined with other substances But the extent to which they are available to plants and animals in their combined states, and whether the toxic effects are reduced by chemical combination, is much less understood (13)

The effect of the toxicity of the heavy metals shows in two special patterns, (i) Risk arises where a toxin is discharged into the environment, particularly where the discharge is steady However, accidental spillage produces an obvious risks where a low though continuous discharge may not have been an obvious problem. (ii) Once in the environment, the risk is worsened, if the toxin is bioaccumulated and then biomagnified, i.e. if the toxin can be taken up by living organisms so that progressively through predators, it magnifies to levels greater than the levels found in the environment. However, not all toxins, and not all organisms do this Mercury happens to be one of the worse metals, as far as this aspects concerned The organisms which biomagnify heavy metals also vary There are a few organisms which have the power to absorb the toxin, neutralilse it and convert it in a way such that it is harmless to them, but it could be harmful to the predators which eat them. However, most organisms seem to have the capability of flushing diluted toxins through their systems, although some may fall sick or die in the process Organisms which have the ability to neutralise toxins and keep them in their tissues, are the ones which form biological sink in the environment If such organisms, which bioaccumulate, happen to be a part of human food, then people are at risk They are also at risk if the toxins contaminate feed stock lower down in the food chain The toxin moves from the food to the feeder. If can get concentrated at each level in the food chain. This is called biomagnification and this worsens the situation Biomagnification can either kill or make food resources unsuitable for consumption, or can make these people sick who eat even relatively few affected food items in the chain

All this is of no consequence however, if there are no people to eat or harvest the contaminated food The risk is also not great if the local residents (as is the case in big cities or in industrial countries) do not depend only on food which is locally grown The risk is low in these areas, not only because few people eat the contaminated food, but those who do eat them, eat only few such products, their food being "diluted" by food from other sources (14)

Heavy metals differ from toxic organic compounds in that they are totally non-degradable, since most elements cannot be transmuted, except under truely extraordinary conditions They are therefore, practically speaking, indestructible as they accumulate in the environment. Through the millennia, however, living beings have learnt to live with heavy metal pollution in low doses and have developed certain defence mechanisms One such mechanism is tolerance to a limited degree, as long as the heavy metal ions are confined in non critical places, e g in the non critical portion of the cell membrane, bark, hair etc. A second line of defence is the secretion of mucus metallothioneins (MT) and its analogues, which are low molecular weight protein molecules which bind (chelate) heavy metals such as Zn(II), Cd(II), Hg(II) and thus significantly reduces the release of metals into the organism. Another important defence mechanism is the conversion of the heavy metals to readily excretable forms Sometimes the chemical entity is changed to a volatile form which can readily diffuse out of the cell. For example, Hg(II) gets converted to $(CH_3)_2$ Hg by some bacteria — a form which is not only much less toxic than Hg (II) or CH_3 Hg + but also has a significantly high vapour pressure (15)

From the point of view of environmental degradation, of all the heavy metals, cadmium, lead, mercury and arsenic have been the source of major concern to living beings The toxicity and related topics concerning these four elements, will be presented in the next two issues

REFERENCES

1. Narayan, N S and Madhtastha, M.N. Heavy Metal pollution in India: A Review in Trivedy, R.K. and Goel, P K (ed) Current pollution Research in India Environmental Publication (1985)
2. Alloway B.J. (ed) Heavy Metals in Soils. John Wiley and Sons Inc 1990 pp. 338
3. Nriagu J.O A History of Global Metal Pollution Science 272 (1996) 223 - 224
4. Same as 2 above

5 Baird, C.S Environmental Chemistry. W H Freeman and Co. 1995 pp 484,

6 Hasan and Pandey, S.P. Heavy metals in Urban Water Supplies in Nagpur. in Trivedy, R.K. and Goel, P.K (ed). Current Pollution Research in India. Environmental Publication (1985).

7. Same as in 5 above.

8. Krishnamurthy, C R. and Viswanath P. Health Impact of Environmental Exposure to Heavy Metals· An overview.

9. Same as in 5 above

10. Chiai, E. Toxicity of Heavy Metals and Biological Defence Jn Chem. Edu 72, 1995, 479-483.

11 Same as in 1 above

12. Warren, C S. Protection of the Aquatic Environment· Research Needs in Lack T.J. (ed). Environmental Protection Standards, Compliances and Costs Ellis Harwood Ltd 1984, pp 328

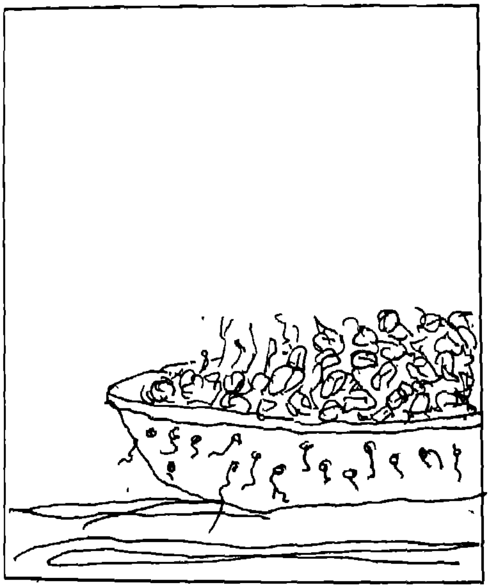
13. Same as in 1 above.

14. Ellts S Environment at Risk. Springer Verlay. (1989) pp 324.

15. Same as in 10 above.

Germination : A Nutritional Wonder

ANURADHA GOYLE
Assistant Professor
Department of Home Science
University of Rajasthan
Jaipur



Germination may be defined as a process whereby the metabolic activity of a seed increases leading to the formation of a protrusion from the seed embryo (Mayer and Poljakoff - Mayber, 1982).

It is well understood that certain environmental conditions are conducive for favourable germination of the grains These factors comprises of the presence of water, air and warm temperature. The first step leads to the immersion of seeds in water, as a consequence of which certain soluble nutrients like proteins, vitamins and minerals leach out into the soak water It is imperative that this loss is kept to a minimum by reducing the volume of soak water and the period of soaking. A soaking period of 6-8 hours would suffice for most of the grains.

After soaking, the grains should be removed and excess water drained off The seeds ought to be lightly rubbed with a cloth to remove the adhering film of water. This film of water does not allow the grains to breathe properly, may make them slimy and furthermore, may even promote fungal growth. It is best to tie the soaked grains loosely in a muslin cloth and keep them in a perforated container for adequate aeration. The seeds should be sprinkled with water every 12 hours or when necessary to prevent the cloth from becoming dry. The bowl should be placed in a warm place to facilitate the process of germination. A germination period of 48 hours would be adequate for most grains but the length of germination period is dependent upon the prevailing environmental conditions.

Germination does wonders as it would be apparent by reviewing the nutritive changes brought about by this humble process To start with, let's take the macronutrients The complex carbohydrates present in the grains in the form of starches are broken down to simpler carbohydrates, the monosaccharides (Khetarpal and Chauhan, 1990, Parameswaram and Sadasivam, 1994) These simple sugars can be easily absorbed from our gastrointestinal tract Similarly, the complex proteins are degraded to smaller peptides and aminoacids making the proteins readily available to our biological system (Savelkoul et al , 1991) Moreover, there is a reduction in antinutritional factors on germination (Sattar et al , 1990, Savelkoul et al , 1991)

An enhancement in the contents of certain vitamins is also noticed Vitamin C increases manifolds (Akinlosotu and Akinyele, 1991). The vitamin B complex is synthesized during germination It has further been observed that the bioavailability of iron and other minerals is augmented (Gahlawat and Sehgal, 1994).

The nutritive changes in carbohydrates and proteins are attributed to the enzyme elaboration occuring during germination (Savelkoul et al 1991). When the dormant seeds are soaked in water, these seeds become metabolically active, thereby, activating the enzymes as well The seed prepares itself for consequent growth that follows, the growth of a seed into a plant. In the process of preparing a seed for its growth it metabolises the complex compounds and creates a pool of nutrients to facilitate its development.

It is, therefore, proposed that these germinated grains be consumed by man for his nutritional gain Hence, the germination process would have to be terminated when it would furnish maximum benefit The point when seed has rendered its nutrients in the available form and where it does not start excessively utilising them for its own growth would be the juncture of termination of germination period. The period of germination would be different for different grains. When the sprout length is about 1-3 cm, one could remove the grains from germination and prepare them for consumption.

The germinated grains can be had raw in salads or in sauted seasoned form These could be utilised to stuff paranthas, sandwiches, samosas, kachoris and many other food items. Dals can be prepared from germinated legumes, too One can think of any recipe where whole grains are employed and these can be substituted by germinated grains to maximize the nutritional advantage

Another feature which lies hidden from us is the efficacy of grains in the malted form Grains which have been germinated and dried are called malted grains The germinated grains can be dried in the sun, or in an oven at a low temperature. The malted grains can be powdered and used in RTE (ready to eat) infant mixes. The amylase rich powders, as these are often called have the inherent property of reducing the viscosity of the cereal gruels, thereby, increasing the caloric density of the feed The enzyme amylase, does the job. One could even add a little of this amylase rich food (ARF) to any gruel and interestingly the viscosity of the product drops down which would mean more of the basic ingredients getting incorporated into the gruel, augmenting the caloric values of the product (Darling et al , 1995, Sumathi et al , 1995)

With an over-view of all these

benefits, it is beyond doubt that we, the nutritionally aware, would use the germinated and malted grains for our maximum good

REFERENCES

1. Akinlosotu, A and Akinyele, I O (1991) The effect of germination on the oligosaccharide and nutrient content of cowpeas *(vigna unguilata) Food Chemistry*, 39, 157-165

2. Darling, J C., Kitundu, J.A Kingamkono, R R, Msengi, A E Mduma, B Sullivan, K R. and Tomkins, A.M (1995) Improved energy intakes using amylase digested weaning foods in Tanzanian children with acute diarrhoea *Journals of Pediatrics Gastroenterology and Nutrition*, 21 73-81

3. Gahlawat, P and Sehgal, S (1994) In vitro starch and protein digestibility and iron availability in weaning foods as affected by processing methods *Plant Foods for Human Nutrition*, 45, 165-173

4. Khetarpaul, N and Chauhan, B M (1990) Effect of germination and fermentation on available carbohydrate content of pearl millet *Food Chemistry*, 38, 21-26.

5. Mayer, A M and Poljakoff-Mayber, A, (1982) *The Germination of Seeds*, Pergamon Press, Oxford, 1-37

6. Parameswaran, K P. and Sadasivam, S. (1994) Changes in the carbohydrates and nitrogenous components during germination of proso millet *(Panicum miliaceum) Plant Foods for Human Nutrition*, 45, 97-102

7. Sattar, A, Atta, S and Akhtar, M A. (1990) Effect of irradiation and germination on trypsin inhibitor and protein content of chickpea *(Cicer arietinum L) International Journal of Vitamin and Nutrition Research*, 60, 402-406

8. Savelkoul, F.M M G., Poel A.F B Vander and Taminga, s (1991) The presence and inactivation of trypsin inhibitors, tannins, lectins and amylase inhibitors in legume seeds during germination A review, *Plant Foods for Human Nutrition*, 42, 71-85

9. Sumathi, A, Malleshi, N.G. and Rao, S V (1995) Elaboration of amylase activity and changes in paste viscosity of some common Indian legumes during germination. *Plant Food for Human Nutrition*, 47, 341-347

Discovery of Vitamins*

P MAHESHWARI
Department of Botany
Delhi University

There is an ancient eastern saying " Better to walk than to run, better to sit than to walk; better to sleep than to sit, and better to die than to wake" This is certainly applicable to the many who are undernourished, for the fire of life burns low in their bodies and they are apt to take things as they are instead of making an all out effort to get over their troubles Not every case of undernourishment and ill health is , however, due to poverty, surprisingly enough, some are associated with wealth and abundance It is the purpose of this article to consider one such aspect

As is well known, our foods contain proteins, carbohydrates, fats, mineral salts and water Those that are derived from plants also have some fibrous material. This "roughage" has little nourishment in it, but is valuable for enabling the intestines to push the food forward

Besides the above, foods also contain minute quantities of other substances Although not concerned directly in making protoplasm, or in oxidation, the absence of these things gives rise to what are known as deficiency diseases To this category belong the vitamins Although every school boy or girls talks of vitamins these days, no one had any clear knowledge of them until about sixty years ago.

Scurvy, a disease caused by vitamin deficiency, was mentioned in the writings of Hippocrates (430-370 B C) the father of western medicine, as a scourge of armies and exploring seamen. It was recognised by a weakening of the walls of the capillaries so that blood escaped easily through them Large black bruises were formed, blood came out of the nose, the gums became soft and swollen and frequently the teeth fell out Sometimes the feet became swollen so as to produce a dropsical condition and the breath became offensive Barber-surgeons were employed to cut away the dead flesh from the gums to enable a sufferer to masticate his food After considerably misery, many of the victims died

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* This article has been reproduced from Vol 1, No. 1, March 1962 issue of School Science' In this article late Prof. P Maheshwari, FRS, had presented the chronology of events that led to the discovery of vitamins. Today, the role and function of vitamins is a common knowledge but it was not so just a hundred years ago. The ideas presented in this article not only describe the manner in which the vitamins were discovered but it also provides an excellent examples as to how the method of science viz careful observations, meticulous recording of the data, experimentations, inference and predictions have helped the human beings to unravel one of the mysteries of nature,

Scurvy is **repeatedly** mentioned in the records **of the Crusades** during the thirteenth **century. It appeared** very frequently in **places where** people lived on a restricted diet as in encampments of soldiers in besieged towns During the 16th, 17th, and 18th centuries explorers going on long voyages suffered so badly from its ravages that it became known as the "calamity of sailors" Two-thirds of Vasco da Gama's crew died from it off the cost of Africa, it had a deadly effect on Magellan's men, and it had been taken quite seriously by Francis Drake The heavy mortalities on Columbus' voyages were also due mostly to scurvy.

No one knew the cause of the disease Some blamed sea air, while others attributed it to the consumption of salted meat

In the **winter of** 1536, Jacques, Cartier, the French explorer who discovered the St. Lawrence River, made his second voyage to Newfoundland and spent a winter in a American Indian Village near the present site of Montreal Out of a crew of 110,26 died of scurvy, and others would probably have met a similar fate if they had not followed the advice of the natives and drunk a tea made of spruce needles. The results were "miraculous" If all the physicians of Montpellier and Louvain "had been there", said Cartier, "with all the drugs of Alexandria they would not have done so much good in one year as that tree did in six days"

The voyage of James Cook **in** the 18th **century** are especially **noteworthy in** this connection On the first voyage Cook lost so many men by scurvy that he swore that "if his own life was spared he would devote all his intelligence and energy to combating scurvy" On the second voyage after spending **several** months at sea in the region of the **Antarctic** Circle he landed in **New Zealand.** Here he gathered the buds and needles of a pine, brewed them with molasses and malt, and made a decoction which benefited his men immensely Several years before Cook's first voyage, a Scottish naval physician, James Lind (1716-94) made an interesting experiment on board the *Salisbury* He divided twelve men suffering from scurvy into six groups of two each. Two men were given cider each day, two vinegar, two oil of vitriol, two half a pint of sea-water, two a patent lactuary, and the last two a couple of oranges **and one lemon.** The fortunate ones who **received** oranges and lemons were cured **in** six days, the cider drinkers showed a slow improvement, while the other pairs remained almost as before

Lind's own account of his test is as follows. "On the 20th May, 1747, I took twelve patients in the scurvy, on board the Salisbury at sea Their cases were as similar as I could have them Two of these were ordered each a quart of cyder a-day Two others took twenty-five drops of elixir vitriol three times a-day Two others took two spoonfuls of vinegar three times a-day upon an empty stomach.. Two of the worst, were . put under a course of sea-water. Two others had each two oranges and one lemon given them every day The two remaining patients, took the bigness of nutmeg three times a-day of an electurary recommended by an hospital surgeon...

"The consequence was, that the most sudden and visible good effect were perceived from the use of the oranges and lemons, one of those who had taken them, being at the end of six days fit for duty. The other was the best recovered of any in his condition; and being now deemed pretty well, was appointed nurse to the rest of the sick .."

At another place, he wrote· "Some persons cannot be brought to believe that a disease so fatal and dreadful can be prevented or cured by such easy means. They would have more faith in some elaborate composition dignified by the title of an antiscorbutic golden elixir or the like. Facts are sufficient to convince the un-prejudiced. It is no easy matter to root out old prejudices or overturn opinions which have acquired an establishment by time, custom and great authorities".

In 1753 Lind wrote a book in which he mentioned the case of a sailor who had gone to Greenland in 1834 He was so sick with scurvy that his companions marooned him to die He had nearly lost the use of his limbs and could only crawl over the ground. Even in this hopeless condition, the cravings of hunger overcame the despairs of his disease and he grazed like a beast upon the young shoots of green grass In a short time he recovered and returned to his companions

Since fresh vegetables could not be carried long distances in those days owing to the lack of refrigeration facilities, in 1795 the British Admiralty decided to adopt lemon juice as the principle antiscorbutic After this the incidence of scurvy showed a startling decline in the Navy, although no one knew the exact reason for this Even so, owing to lack of fresh fruits thousands of Indian soldiers died in Iraq in World War I

Ancient Chinese records, as old as 2,700 B C., show that in the East there was another disease which paralysed and rotted the muscles and turned men into living skeletons In this there was no bleeding as in scurvy but numbness and paralysis This disease began to be known as beriberi

Nearly a third of the Japanese soldiers used to be on the sick list because of this trouble About 1880 Takaki, Director of the Tokyo Naval Hospital, decided that it was not due to climate or sanitary conditions and suspected the diet He sent two warships on a long journey The *Ruyajo* had the usual rations, in which white or "polished" rice predominated. The *Tarkula* carried less rice but more barley, meat, vegetables and condensed milk. On the first ship about one-third of the sailors suffered from beriberi, and several died of it On the second only 16 out of 350 became sick and in every case it was shown that the sailor had not eaten his full allowance of the new foods but persisted in eating white rice

The Japanese Government immediately ordered that other foods be provided in addition to polished rice. Very soon the beriberi outbreaks became less frequent For practical purpose this solved the problem Yet neither Takaki noi anyone else knew the real connection between the altered diet and the reduction in deaths due to beriberi Takaki conjectured that it was due to protein deficiency.

Towards the latter part of the nineteenth century the Dutch were rapidly infiltrating in the East Indies In the island of Sumatra they fought against the Achinese, inhabitants of the northern part having their capital at Kotaradja For a quarter of a century the Duch won many battles and yet they steadily lost the war They had superior weapons but the army was torn to shreds by beriberi. Hospitals were rapidly built but were swamped in no time while disease continued to increase in volume and intensity. This appalling condition caused the Dutch to write for help to their colleagues in the Universities of Leyden, Utrecht and Amsterdam The home Government sent a Commission consisting of several doctors who worked diligently in Java for nine months hunting for some microbe which may be responsible for the disease. Since they failed to find any microbe they simply left instructions with the Javanese doctors to use plenty of corrosive sublimate to sterilise the rooms in the hospital. One member of the commission, Christiaan Eijkman (1858-1930), a former student of Robert Koch, was left to investigate the matter further

Eijkman had studied with Koch in Berlin He examined secretions, blood, and everything else trying to find a bacterium but failed He tried the customary method of injecting sputum and blood from the patients into chickens but was unable to produce any symptoms of beriberi in them

On one fateful day (June 10, 1889), his assistant came to report that the chicken feed had been exhausted Eijkman asked him to see the head cook of the hospital who permitted him to use the remnants of the cooked hospital food. So from the next day the chickens began to get a civilised food consisting of nice, clean, cooked, polished, white rice After a month peculiar symptoms were noted in the poor birds. Many of them became sick, emaciated and paralysed and could not even sit up. The disease advanced from legs to wings, tail to head, and slowly but surely ended in death. On November 20th, a new Superintendent arrived and being rather economy-minded he decided to stop the supply of the expensive white rice which was meant for patients and not birds and resumed the quota of the usual dirty brown crude rice Lo and wonder! The sick birds rapidly recovered.

This was so impressive the Eijkman immediately gave up the search for a microbe and began to look into the food The experiment was repeated several times until he became convinced that birds eating nothing but polished rice always died from this strange paralysis (polyneuritIes) while birds eating crude, dirty, unpolished rice or picking their own food on the dunghill never got it.

This naturally led him to examine the brown skin on the rice He made a decoction of it and forced it down the throats of the paralysed chickens Within four hours they began to recover and were perfectly well next morning

Now the mystery began to clear up. The Dutch soldiers had beriberi because they ate the most expensive polished rice The Achinese ate the cheap crude, unpolished rice and were therefore free from the disease.

Experiments tried on labourers, prisoners and others fully confirmed this In 1905 one Dr Fletcher performed an interesting test on the inmates of a madhouse. The lunatics were lined up The even numbers were marched to the western ward of the asylum and fed on unpolished rice and the odd numbers marched to the eastern ward and given the usual polished rice A year later in the western ward there were no new cases of beriberi and no deaths, in the eastern ward there had been several deaths and most of the lunatics were sick.

The same experiment was made on 300 Javanese labourers, who were divided into two camps In Camp A living on polished rice there were 20 cases of beriberi in less than 2 months; Camp B living on unpolished rice had none. Now the doctors reversed the diets The patients of Camp A recovered while Camp B reported an outbreak A similar experiment was tried on some 10,000 prisoners. There was only one case among those who were given unpolished rice, but 3900 among those who were fed on polished rice

After this knowledge the beriberi hospital at Buitenzorg had little use, it was soon closed for want of inmates

The explanation first offered by Eijkman for the production of beriberi during the consumption of polished rice was that the disease is due to a state of intoxication brought about by the consumption of excessive quantities of starch and that in the so-called 'silver-skin' which is removed by polishing there is a substance which counteracts the toxic products of the disturbed metabolism This hypothesis was far-fetched and ingenious, but the conception of disease as the direct result of a specific deficiency in food was foreign to the thought of the time It was somewhat later, partly owing to the work of others and partly owing to more extended experiments of his own, that Eijkman came to the definite conclusion that there is present in rice polishings a substance differing from the then known food constituents, but essential to normal nutrition, though required in very small amounts

While Eijkman was busy with beriberi, there were chemists moving towards the vitamin mystery from an entirely different angle. They were not trying to cure diseases but developing the science of nutrition There was a great craze for securing a concentrated ration which had enough of all the recognised food elements in it to keep soldiers going for long periods. They claimed to be able to make the purest of pure diets (balanced bottles for bouncing babies) having exactly the right weight of carbohydrates, the right weight of protein and fat, and correct amounts of the appropriate mineral salts

The chemists thought that at least they had perfected the whole business of food and feed As a first step this synthetic stuff was tried on rats They were surprised to find that it did not work Children fed on such diet developed "Barlow's disease" which is a kind of infantile scurvy.

Since milk is the most of all foods, in 1884 Lunin, pupil of the famous Professor G. Bunge of the University of Basel, fed mice upon an artificial mixture of all the constituents of milk which were then known, namely protein, fats, carbohydrates and salts He found that upon such a mixture the animals failed to survive and was forced to conclude that "a natural food such as milk must therefore contain besides these known principal ingredients small quantities of unknown substances essential to life".

Pekelharing (1848-1922) of Holland also came to a similar conclusion in 1905 and decided that there must be an unknown substance in milk which even in very small quantities is of paramount importance to nutrition In the absence of this substance the organism loses the power to assimilate the principal parts of food, the appetite is lost and in spite of apparent abundance the animals die of want.

The famous biochemist F.G. Hopkins, of Cambridge, kept two sets of similar rats in different cages. The rats in cage I were fed enough prepared food in the form of protein, fat, sugar, and salts to be considered a balanced diet. Those in cage II were fed exactly the same diet, plus a certain amount of fresh milk The rats in cage I lost weight and became ill those in cage II increased in weight and remained healthy In 1907 he further demonstrated that when small quantities of only some butterfat were added to the food it had a remarkably beneficial effect on the rats. Just as Eijkman had concluded that there was something in the unpolished rice, that prevented beriberi, so Hopkins was led to think that there was an "accessory food factor" in butter fat which had a definite effect on the health of his rats Hopkins and Eijkman shared the Nobel Prize for medicine and physiology in 1929

Meanwhile, E V McCollum at the University of Wisconsin was also carrying on feeding experiments on rats. He have them measured and what he believed to be correct amounts of pure carbohydrates, proteins, fats, minerals and water However, the rats developed an eye-disease, became sick and died The experiment was repeated, but this time as soon as the animals became sick some were given a small amount of raw milk (3 ml per day) in addition to their regular diet These rats regained their health and became normal. It now became clear that raw milk contained some substance which was essential for the health of the rats. At first McCollum conjectured that milk supplied flavour to the diet which was otherwise tasteless and flat and disliked by the animals but later the beneficial effects were traced to the butterfat inside the milk.

Such observations greatly stimulated further research on these problems and in 1911 a Polish scientist, Casimir Funk separated from 400 Kg. of rice-polishings just a few grams of impure but tremendously potent crystals Only a minute quantity of this substance could cure a paralysed chicken in three hours He called it "vitalamine"—**vital** because it is essential to life, and **amine** because he considered it to be akin to amino-acids This name was shortened to vitamine and then to vitamin

Earlier in 1980, an English doctor, T A Palm, made some observations on rickets and pointed out that it was commonest in places where there was least sunlight and rarest wherever sunshine was abundant. He examined the remains of Egyptian mummies and found no evidence of rickets in their skeletons—thanks, he suggested, to the African sunlight In the sunlit east purdah women suffered from osteomalacia, a gross form of adult rickets in which the skeleton becomes porous and collapses.

Leonard Findlay, working at the University of Glasgow, found in 1908 how to produce rickets artificially in puppies He gave them nothing except a little milk and oatmeal porridge and kept them in laboratory cages The animals failed to grow their legs, became deformed and weak, their chests compressed, ribs knobbed and spines curved The poor pups became quiet and lethargic Another group, fed similarly but allowed to run about in the open, did not contract rickets and at first Findlay thought that muscular exercise must be the cause of the difference.

In 1917, Mellanby of the Medical Research Council of Great Britain tried to supplement the milk and porridge diet giving one thing after another but without any effect. Finally he landed upon cod-liver oil and the result was spectacular. The warped bones of the pups became straight and strong and their broken spirits were mended. They soon became frisky and active

Another scientist at the John Hopkins University, named McCollum soon isolated from cod-liver oil the active substance which he called vitamin D

At the same time German scientists found that rickets could be cured merely by sunbaths. Those who could afford these went with their children to spend the vacation in Italy, Spain or North Africa, but this was hardly possible for the poor So they were exposed to ultraviolet lamps Within two months there was remarkable effect, The babies were no longer weak, whimpering and apathetic creatures but became full to spirits and mischief

The advantage of light clothing, shorts, open-neck shirts and bare legs is therefore obvious, for this causes the ergosterol in the body to become converted into calciferol. The old village custom of anointing babies with mustard oil and letting them play in the open is thus of great advantage in helping them to maintain their health

The experiments of Eijkman, Hopkins, Funk, McCollum, and others had by now definitely established the presence in food of minute amounts of important substances There followed a vast amount of experimentation which still continues. We now know of more than a dozen vitamins necessary to our health and general well-being. Some of these are available in the form of pills which we can use to supplement our diet However, there may yet be many undiscovered vitamins necessary to us For this reason, as well as for the sake of economy, it is better to depend on natural foods rather than on drug stores for one's vitamins

There is an interesting old story in this connection about the London and Dublin zoos It is said that the London zoo had enough money so that the keepers brought for their lions the kind of meat which human beings use i e. steaks and chops, yet the lions were weak and sickly The Dublin zoo was short of money; so the keepers bought worn-out and old horses and used the entire carcass from nose to hooves, insides and all The lions were healthy and full of pep, prancing and roaring The Londoners were puzzled at this difference. Travellers, who had been to Africa, knew that the diet of lions consisted of zebras. Now the lions did not eat just chops and steaks, they ate the whole zebra, the diet thus matching with that provided by the Dublin zoo Among human beings the poorer folk who eat potatoes, skin and all, are healthier than the richer folk who eat them after the skin is peeled off. This is because the most valuable part of the potato, both from the point of view of starches and vitamins, is immediately under the skin. In peelings with the knife this part is thrown away and lost. Those who eat wheat should keep in mind that whole wheat (daliya) is better than flour and that the coarse brown flour is better than the fine white flour. In the making of the latter the bran which is rich in vitamins, phosphorus, iron and protein is discarded. If a pigeon is fed on white bread alone, its wings droop and it soon becomes too weak even to stand up. If its diet is not changed, it will die If, however, even after it is unable to stand, a little water in which the bran of the grain has been soaked is poured down its throat, it soon revives and becomes normal. When we reject the bran, we lose this essential substance

Our present knowledge of vitamins teaches us that the care and cooking of food is an important as the choice of food if you want to have your full supply of vitamins. In general, exposure to oxygen destroys vitamins, and the higher the temperature the more rapid is the destruction Vegetables should if possible, not be peeled or cut up before cooking; the smaller the pieces the more the surface exposed to oxygen Further, it is desirable to do the cooking in closed vessels because in this way air is excluded. And since water contains air until boiling drives it out, it is best to start the vegetables in boiling water.

Extreme heat, especially in the presence of oxygen, destroys some vitamins, particularly vitamin C and vitamin A For this reason cooking should not be continued longer than necessary. You can thus save your health as well as your fuel.

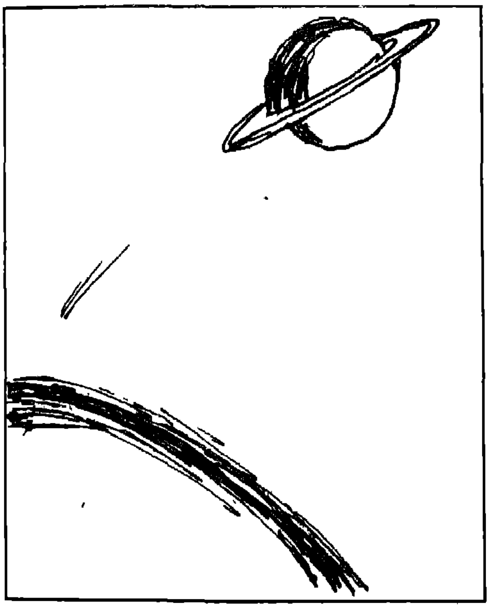
Most vitamins, with the exception of vitamins A and D, are soluble in water. We should, therefore, used only small amounts of water in the cooking pot and whatever water is left should be kept and used, since vitamins (and minerals) are dissolved in it.

During recent years nutritionists have been interested in the possibility of fortifying or enriching certain foods that are most widely used. Nearly all oleomargarine in the U.S.A. is now enriched with vitamin A to make its nutritive value nearly equivalent to that of butter Much of the flour and bread in the U.S.A. and Europe is enriched with niacin, riboflavin and iron For the poorer people of the orient the best policy is to use brown rice, whole wheat (or coarse flour), unpeeled potatoes and as much of fresh fruit and vegetable as possible And the cheaper fruits and vegetables like *ber*, *jamun*, *methi*, *palak*, *bathua*, etc., are often as good as or better than the costlier ones Also, as explained before, except in the winter it is best to put on as few clothes as possible Neckties, socks, long-sleeve shirts and jackets may be signs of civilization, but in a climate like ours they do positive harm to health

At present about 18 vitamins have been distinguished and their number is continually increasing Not only their physiological effects but chemical compositions and constitutions have also been ascertained As to their chemical action, vitamins are either coenzymes, in the absence of which enzymes cannot act, or they are constituents of co-enzymes

Learning School Physics through Analogical Approach

B.K. SHARMA
Reader
Department of Education in Science and Mathematics
National Council of Educational Research and Training
New Delhi 110 016



The study of physics forms the fundamental basis for understanding basic laws of nature governing various events and physical phenomena occurring in all domains of life. Understanding of physics, therefore, leads to applications in diverse fields of scientific world, encompassing the entire gamut of advancements in science, technology and society. A complete understanding of physical phenomena, however, requires deeper knowledge of basic principles, logical understanding of conceptual framework involved and the generalisations for wider and universal applicability through methods of mathematical description, theoretical foundations, experimentation, logical thinking and analysis It is often observed that mathematical relationships which appear on various themes in different areas of physics and even in other sciences, covering variety of physical phenomena (mechanical translational, mechanical rotational, acoustic, optical, thermal, electrical and magnetic system) are almost exactly the same Therefore, many phenomena have some common features, similarities or analogues in diverse systems For example, the propagation of sound waves is, in many ways, analogous to the propagation of light waves. Similarly, an electric current flowing across a conductor under the action of a potential difference between its two ends is somewhat analogous to volume rate of flow of water through a tube due to a pressure difference between its two ends Also, the flow of heat through a conductor (as the electrons are primarily responsible for the conduction of heat in conducting material) under a temperature difference between its ends is in many ways, analogous to water flowing through a pipe or to the charge flowing through a wire. Although we admit that water flowing in pipes is not in every way analogous to electric charge flowing in conductors, it turns out that remarkable and memorable similarities crop up both conceptually and mathematically from system to system The magnetic system is also very important because it interacts with the electrical system and serves as a link between electrical and mechanical system Therefore, the study of phenomena in one field may possibly permit an extension to our knowledge in many diverse phenomena in other fields

Any conscientious physics teacher is expected to attempt to point out similarities between one topic in an area with that in other areas The systems which have conceptual similarity or even identity are normally discussed separately in sequence as per the prevalent practice in the school system. To develop a proper understanding about different systems which have some common features and it could be easier to learn about one system in detail and then to draw an analogy with it to understand how another system works on a similar theme.

An analogical approach can make it easier to understand more complicated systems, which are mixtures of two or more systems. The analogical approach to learning school physics is expected to benefit the learner in an number of ways such as promoting sequential development of concept-oriented knowledge, avoiding rote memorisation of mathematical formulae, perception of new ideas and their correlationships with similar themes, critical thinking, searching for logic, understanding cause and effect relationship, ability to think independently, capability to analyse unfamiliar situations and rational understanding of the topic. Such an approach is expected among learners in inculcating self-confidence, reasoning power, rational outlook, positive attitude to enhance perseverance for better learning, analytical mind and appreciation of truthfulness which help in appropriate decision-making in real-life situations as a scientifically literate citizen. Thus, through the analogical approach, it is possible to accomplish a satisfactory theoretical understanding of certain newly encountered obscure phenomena However, it may be realised that such extensions and parallelisms are possible, although exact correspondence may not be made

Historical Background

The method of devising analogy between various classes of physical phenomena has played a key role in the overall development of physics from the beginning For example, Torricelli and Pascal (1643) described atmospheric pressure at the earth's surface analogous to hydrostatic pressure exerted by ocean at its bottom; Coulomb (1785) proved the validity of inverse square law of distance for magnetic and electrostatic forces based on the analogy with Newton's inverse square law of gravitation on 'action at a distance' The law was subsequently extended to light illumination, sound, radiant and thermal energy successfully Poisson (1824) pointed out that Laplace's description (1782) of gravitational attraction with potential functions could be well utilized in describing electric and magnetic interactions Electric potential difference which indicates the direction in which a free positive charge tends to move, is analogous to the temperature difference in heat flow in a direction from a body at higher temperature to that at a lower one, to the flow of liquid from a higher to a lower level in hydrodynamics; to the pressure difference which determines the flow of air or any other fluid from a higher to a lower pressure, Carnot's formulation (1824) for efficiency of a heat engine was analogous to constant quantity of water flowing over the top of a water fall and falling to the bottom, Ohm's law (1826) for current flow was based on Fourier's analystic theory (1822) of heat conduction. Thomson (known later as Lord Kelvin) (1856), while formulating his law of thermoelectricity, compared the thermocouple with Carnot's reversible heat engine that absorbs heat from the source (hot junction), does work in transferring charge in the thermocouple and rejects the remaining heat at the sink (cold junction). 'Thomson coefficient' which is the electromotive force (e m f) due to unit difference of temperature in a conductor, is sometimes referred to as 'specific heat of electricity'. Analogous to specific heat in metals. Thomson imagined the process of heat transfer, when current flows in a conductor whose ends are maintained at different temperatures, is analogous to that of a liquid absorbing heat when it flows in a tube heated at one end

How to Devise Analogy

The mathematical equation for a harmonic oscillator in various systems appears again and again in many physical phenomena Some of these include oscillation of mass on a spring, pendulum with a small swing, oscillations of charge carriers in an electrical circuit; vibrations of a tuning fork, the vibrations of electrons in an atom and mechanism for operation of servo-System (such as thermostat that adjusts the temperature, complicated interactions in chemical reactions etc.)

Perhaps the simplest mechanical system whose to-and-fro motion about the mean (equilibrium) position follows a linear differential equation with constant coefficient, is a mass (the block) connected through an elastic spring to a rigid support (the wall) and placed horizontally on a frictionless surface. This mechanical harmonic oscillator (i e oscillating mass-spring system) with a spring of spring constant or stiffness constant K can be set in motion by stretching the mass m (by pulling the mass through a displacement x and let it go. Such a mechanical harmonic oscillator is analogous to an oscillating LC (resistance less inductor-capacitor series system) circuit The solution and interpretations of solution in both these cases leads to many a characteristic features concerning the two phenomena. The analogy between them can therefore, be established easily. For example, the expression for potential energy U_s (= ½ $Kx^{2)}$ (as the elastic energy in a spring) of a compressed or an extended spring is like the charged Capacitor (initially charged with a charge similar to that for stored electrostatic energy E_e (=½ (q^2/C) of a charged capacitor of capacitance C initially charged with a charge in an electric field. Similarly the moving mass m (as a measure of inertia in linear motion) with velocity $v(=dx/dt)$, having kinetic energy U_k (=½ mv²) has an electrical analogue, in an LC circuit in the form of inductor (with inductance L) through which a changing current i(=dq/dt) flows (due to the discharging of the capacitor) and oscillates back, resulting in the magnetic energy E_L (=½Li²) due to the magnetic field around the inductor.

It is interesting to note that in each case, there is a continuous transformation of energy C (from kinetic to potential energy and vice versa) which keeps the mass oscillating in the mass-spring system. It is analogous to the transformation of energy (from the magnetic to electric energy and vice versa) which keeps current oscillating in an LC system. Twice during each cycle, E_L and E_C attain their maximum value in LC system while the same is true for U_k and U_S in mass-spring system However, at any given instant of time, in the oscillating mass-spring system (with no friction), the total mechanical energy U (i e. the sum of kinetic energy U_k and the potential energy U_S) remains constant (i.e du/dt=0) with time, even though v and x vary This holds good only if the mass spring system is frictionless so that no energy is dissipated due to frictional resistance. Similarly, no energy is dissipated in a resistance less LC circuit and the total electromagnetic energy E (i.e. the sum of magnetic energy E_L of the inductor and electrostatic potential energy Ec stored by the capacitor) remains constant with time, even though i and q vary with time The conservation of energy considerations lead to analogous expressions for the two systems. We can arrive at analogous expression for the natural angular frequency of oscillations of an oscillating mass-spring system and an Lc circuit by the conservation of energy considerations .

Equation for mechanical simple harmonic oscillations (frictionless) of a mass on a spring, with natural angular frequency of oscillations W_0 and the period T is

$$\frac{d^2x}{dt^2}\ \omega_0^2x = 0;\ \text{with}\ \omega_0 = \sqrt{\frac{K}{m}}\ ,$$

$$T = \frac{2\pi}{\omega_0} = 2\pi\sqrt{\frac{m}{K}}$$

A closer look at the expressions reveals a close correspondence between the oscillations of resistance less LC circuit and the frictionless mass-spring systems. It may be noted how x,v,k, and m in mass-spring system correspond so closely to q,i, I/C and L respectively in the LC circuit It is also interesting to note how in each case the energy alternates between two forms; between magnetic and electric energy in an LC system, and between kinetic and potential in a mass-spring system. Moreover, the total electromagnetic energy and the total mechanical energy remains conserved in both the systems Figures (a) and (b) respectively show set up of mass-energy system and mechanical and electrical oscillate LC circuit. Fig (C) shows the kinetic energy U_k, potential energy Us and their sum U as functions of the displacement x in the mass-spring system Fig (d) shows the stored magnetic energy E_l and electric energy Ec and their sum E in a LC circuit as functions of the time with the period T of the oscillations

It has been observed in the case of

mass-spring system that greater the mass on the spring, slower are the oscillations and stiffer is the spring, faster are the oscillations Similar situation is observed in case of torsional oscillations of a body Suppose a body with a moment of inertia I is suspended by a wire of torsional constant K If the wire is twisted through an angle ϕ such that the body begins to execute torsional oscillations about the vertical axis. Then the angular frequency ω_0 is

$$\omega_0 = \sqrt{\frac{K'}{I}} \quad \text{and period } T = 2\pi\sqrt{\frac{I}{K'}}$$

having torsional constant K and moment of inertia I about the fixed axis. The angular harmonic motion of the balance wheel of a watch is isochronous (its time period is quite independent of its amplitude for small swings) and the watch keeps time even though the amplitude of oscillation decreases as the main spring unwinds In case of LC oscillations on the other hand, greater the value of L or C , the slower are the oscillations and vice-versa

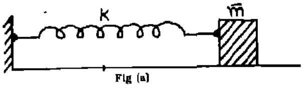


Fig (a)

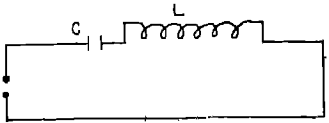


Fig (b)

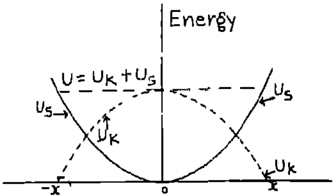


Fig (c)

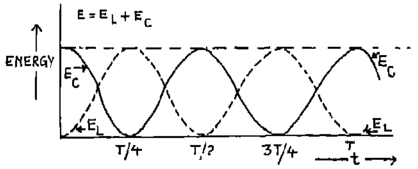


Fig (d)

It may be recalled that the inertia of a body or a system is a property which is a measure of the opposition offered by it against any change in its state of motion. Mass 'as a measure of inertia' in linear motion determines how much force it needs to achieve a certain amount of acceleration The work done by the net applied force gets transformed as the kinetic energy of the moving objects An object with a large mass needs to have more work done on it to attain a certain velocity and hence is harder to start or stop Similarly, in case of rotatory motion the greater the net torque required to produce a given angular acceleration the greater is its movement of inertia or rotational inertia about the axis of rotation. The rotational inertia (as a measure of inertia against turning) of a rotatory body and the inductance of an inductor (as a measure of its inertia or opposition against the change in current) in the electric system are respectively the rotational and electrical analogous to mass of a body in linear motion

Magnetic systems too bear some resemblance to electric system A current carrying solenoid provides a practical way to establish a uniform magnetic field, just as a parallel-plate capacitor establishes a uniform electronic field In doorbells and loud speakers , a solenoid often provides the magnetic field (i.e. the force) that moves (i e) accelerates a magnetic material over the cross section.

Consider a solenoid of length l and cross-sectional area A having N turn with its core containing a medium of permeability U The magnetic flux ϕ linked with each turn of the solenoid carrying current i, produces a magnetic field of magnitude B perpendicular to the plane of the coil The magnetic flux $\phi = B\,A = \mu\,NA\,i/e =$

$$\frac{Ni}{\left(\frac{1}{\mu}\,\frac{1}{A}\right)} = \frac{F_m}{R_m} = \frac{\text{Magnetomotive force}}{\text{Reluctance}}$$

An analogous expression for the current i in terms of electromotive force (emf) ε and resistance R of the electric circuit is

$$\text{Electric current } i = \frac{\text{emf } \varepsilon}{\text{Resistance R}} = \frac{\varepsilon}{\left(\rho\,\frac{1}{A}\right)}$$

It may be noted that the reluctance Rm of the magnetic system given as $\left(\frac{l}{\mu}\right)\left(\frac{l}{A}\right)$ has the same form as the resistance R of $\left(\frac{\rho l}{A}\right)$ with electrical resistivity of the electric system. The magnetic flux ϕ and magnetomotive force (mmf)F_m in magnetic system are analogous to electric current and emf in electric system. It may be borne in mind that the nomenclature electromotive force or emf for an electric system is somewhat misleading This is because the emf is not a force but is the workdone by the system per unit charge. Similarly, mmf of magnetic system is not a force but is a product of total number of turns and current, also, the reluctance of the magnetic system is not a resistance in the sense that resistors always dissipate some energy from the electric system No energy or power is being lost in the magnetic system while there are power losses in the electric system It is interesting to note that the magnetic system acts as a storage device for the energy of the magnetic field The energy of the magnetic field about a coil (inductor) stored in the inductor when the change is in motion can be designated as stored kinetic energy of the system.

Ohm's Law from the Analogy of the Hydrodynamical Considerations

An impelling cause or external effort (force) is required to bring about any change in a system There is a tendency inherent in the system to oppose such a change. Consequently, some sort of resistance or drag is always associated with the specific type of phenomenon in the system which tries to restrain that change. Mass in linear motion, moment of inertia in rotational motion for a mechanical system are two such examples. Similarly electrical inductance in electrical system and permeability in magnetic system have the effect of slowing down or restraining changes in respective systems Therefore, these physical quantities represent the inertial resistance to the respective impelling causes namely force, torque, electromotive force (emf) and magnetomotive force (mmf) which produce respective changes such as linear velocity, angular velocity, current and flux in these systems

Thus, we may write the general basic principle as

$$\text{Change} = \text{Impelling cause (or force)}/\text{Resistance (or drag)} \qquad \ldots (1)$$

The general basic principle of eq. (1) can be utilised for describing various types of physical phenomena Various changes such as laminar flow of liquid through a tube (in a fluid system) flow of current through a conductor (in electric system) or flow of heat energy through a metal bar (in thermal system) take place under the respective impelling causes namely the pressure difference, potential difference (or emf) and temperature difference between extreme ends of the flow media. Our everyday experience tells us that the flow of liquid through a tube increases when the cross sectional area of the bore of the tube is increased or its length is decreased Then, using eq. (1) we may obtain general principle for the flow rate as

$$\text{Flow rate} = \frac{\text{Impelling cause of flow} \times \text{Area of Cross-Section}}{\text{Resistive factor to flow} \times \text{length of flow medium}} \qquad (2)$$

The general principle for flow rate (eq 2) may now be utilised to describe flow processes in electric and thermal systems and to obtain Ohm's law.,

For electric system

Current (i) or charge flow rate $(\frac{dg}{dt})$

$$= \frac{\text{Potential difference } (V_1 - V_2) \times \text{Area of conductor (A)}}{\text{Electrical resistivity ( )} \times \text{Length of conductor (l)}} \qquad (3)$$

For thermal system

Heat flow rate $(\frac{dq}{dt})$

$$= \frac{\text{Temperature difference } (T^1 - T^2) \times \text{Area of conducing}}{\text{Thermal resistivity } (1/K) \times \text{length of Bar (l)}} \qquad (4)$$

It may be noted that thermal conductivity k describes how well a material conducts heat. The reciprocal of the resistance (i.e 1/Resistance) denotes a factor that promotes the conduction or flow This promotive factor in thermal system is referred to as thermal conductivity, k, of the material of the bar and as electrical conductivity σ (as a reciprocal of electrical resistivity ρ) in electric system The thermal resistance in electrical circuits has a mechanical and fluid analogous in viscous **fluid friction** (viscosity coefficient) and **a thermal** counterpart (less familiar '**thermal** resistance') describing heat flow in conducting materials in analogy with more commonly treated electrical resistance in electric systems

The resistance of a material is known to depend on the nature of a substance as well as its shape and size. The resistance R increases with increasing length l and decreasing cross-sectional area (A) of the conductor so that $R = \rho l/A$ with ρ as the electrical resistivity of the material.

Then, eq (3) can be rewritten as

$$i = \frac{(V_1 - V_2)}{R} \qquad (5)$$

Eq (5) represents well-known ohm's law which has been obtained from the analogy of the general principle (eq 2) for flow rate

The phenomenological similarities between diverse mechanical (translation, rotational), thermal, electric and magnetic systems, possessing some common features, are given in the Table on page 36.

Such an equivalence can be utilised in designing electrical circuits or magnetic systems having desired output It must, however be borne in mind that these analogies are not perfect In spite of such phenomenological correspondences certain inherent dissimilarities do exist For example, in linear motion, the mass as a measure of inertia depends on the quantity of matter alone, while in rotatory motion the moment of inertia (as a measure of inertia against turning) depends on the quantity of matter (mass) as well as shape and size i e distribution of mass about the axis of rotation In elasticity, the inertia depends on the shape or form and the nature or constitution of the specific object, while in electrical or magnetic system, the nature as well as electrical and magnetic conditions of the conductor or magnetic material is important Similarly, no known magnetic phenomenon physically corre-

Mechanical System		*Thermal System*	*Electric System*	*Magnetic System*
Translational	*Rotational*			
Force	Torque	Temperature difference	Electromotive force (emf); potential difference	Magnetomotive force (mmf)
Linear displacement	Angular displacement	Quantity of heat	Electric Charge	Magnetic pole
Linear Velocity	Angular Velocity	Heat flow rate	Electric Current	Magnetic flux
Linear acceleration	Angular acceleration	—	Current-time gradient	—
Linear frictional resistance	Rotational frictional resistance	Thermal resistance	Electrical resistance	Reluctance
Linear spring (capacitors) Capacitance	Rotational spring (capacitor) capacitance	Thermal Capacitance	Electrical Capacitance	—
Stiffness force constant	Torsional constant	—	1/capacitance	Restoring couple
Inertial mass	Moment of inertia	—	Inductance	1/permeability
Translational kinetic energy	Rotational kinetic energy	— —	Electromagnetic Induction energy	Magnetic induction energy
Potential energy	Potential energy	—	Electric potential energy	Magnetic dipole potential energy

sponds exactly to the conduction of current. In electric circuit (which may be open or closed) the flow of electrons constitutes electric current; while in magnetic system (which is always closed), there is no actual flow of separate monopoles (convincing evidence for their existence has not yet been confirmed) and hence a quantity like magnetic current is meaningless The resistance in an electric circuit depends on the nature and dimensions of the conductor and is independent of electric current passing through it whereas the magnetic reluctance in the magnetic system depends on the flux A difference of electric potential drives an electric charge from higher to a lower potential, but no actual motion of any such material object like a north pole is possible due to a difference in a quantity like the magnetic potential. In general, the magnetic force is not conservative and, therefore, cannot generally be represented by a potential energy. However, it is possible to define potential energy for the system consisting of a dipole in a field In general, it is usually not possible to define a scalar magnetic potential energy' of a point charge or magnetic potential' of the field itself in a similar way as in the case of electric fields The potential energy of a magnetic dipole in a magnetic field, similar to the corresponding quantities for an electric dipole, tends to be a minimum when the dipole moment is aligned to the external field. In electrical and thermal systems, both flow of electric charge and heat energy is carried by free electrons, common to all conductors in the system The electrical or thermal proportionality constant or a frictional resistance factor (resistivity, 1/conductivity) describes the behaviour of the conductor A good electrical conductor such as silver is also a good heat conductor and the electrical conductivity is directly related to the thermal conductivity K of the conductor. In fluid system, the frictional resistance factor responsible for opposition to fluid flow in a pipe not only depends on the length of the pipe and its cross-sectional area but also on the roughness of its inner surface, viscosity of the fluid itself and how fast the fluid moves inside the pipe.

Conclusions

An orderly and systematic procedure for devising analogies, through continual practice and training help the learner to attain ability and gain confidence in shaping the power of imagination and analysis Through the analogical approach the learner may gain insight into the theoretical and practical understanding inherent in the conceptual groundwork and physical behaviour of phenomena The learner may then apply adequate knowledge of known basic principles to a variety of those more advanced and complicated theoretical and practical problems in physics whose solution is not immediately or intuitively apparent Eventually this may help in framing new scientific hypothesis It was the result of such imaginative parallelism that Louis de Broglie (1924) could put forward his hypothesis on matter waves based on the analogy of the wave-particle dualism of light Also H. Yukawa (1935) could propose for the meson field analogous to photo field (electromagnetic field)

But at the same time, they were fully conscious of the features of unlikeliness also Niels Bohr (1913), however, accepted Rutherford's analogical planetary model of the atom (1911) with the solar system but also realised the basic difference of mechanism and conceptual framework of the atom from that of the solar system

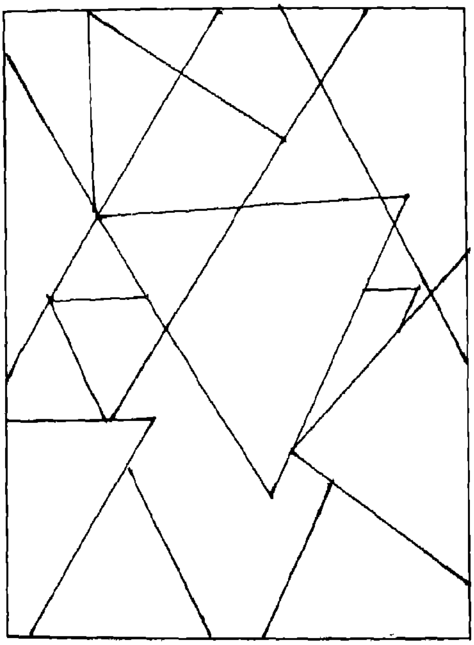
There is a need to realise first the basic limitations of the parallelism and analogical correspondence before these may be utilised for understanding certain obscure phenomena encountered in framing a new hypothesis We must certainly devise convenient and convincing analogies in physics but the basic sense of understanding behind the familiar notions of physical phenomena should not be over-looked.

REFERENCES

1. Robert Resnick, David Halliday and Kenneth S Krane Physics, 4th Edition, Volumes I, II John Wiley and Sons, Singapore, 1994
2. A Textbook of Physics, Class XI, Vol I Parts I and II, Class XI, Vol, II Parts I and II, NCERT, New Delhi, 1995
3. R.P Feynman, Lectures on Physics, 8th Reprint, Vols. I, II and III, Narosa Publishing House, New Delhi, 1995
4. Edward J Dierauf and James E Court, Unified Concepts in Applied Physics, Prentice-Hall, New Jersey, USA, 1979.
5. H.D Young, M W Zemansky and F W Sears, 6th Edition, Narosa Publishing House, New Delhi, 1982

To Construct an Equilateral Triangle Equal in Area of a Given Triangle

MANOHAR LAL VERMA
Lecturer
Y D Inter College
Oel, Kheri



A Triangle PBC is given An equilateral triangle is to be constructed equal to Δ PBC in area

Construction

A line PR is drawn parallel to line BC from the point P After this a line BZ is drawn at the point B making the angle of 60° which meets the parallel line PR at the point A Then points A and C are connected and triangle ABC is constructed whose one angle ABC is 60° and its area is equal to the area of ΔPBC

Suppose side AB of Δ ABC is C and side BC is equal to A Now the base BC is extended to Q After this, CD = AB is formed equal to C Then knowing the mid point M of BD a semi circle is constructed on BD After this a line EC making the angle of 90° is drawn at C point which meets at the point E on the semi circle

Thus the line EC of equilateral triangle is traced whose length will be $\sqrt{ac}$.

Now making BL = EC = LT a equilateral Δ is constructed.

Proof

Suppose the height of Δ ABC is h and the side of equilateral triangle is 2x

So the area of equilateral Δ LBT

$$=\sqrt{\frac{3}{4}} \times \text{side}^2$$

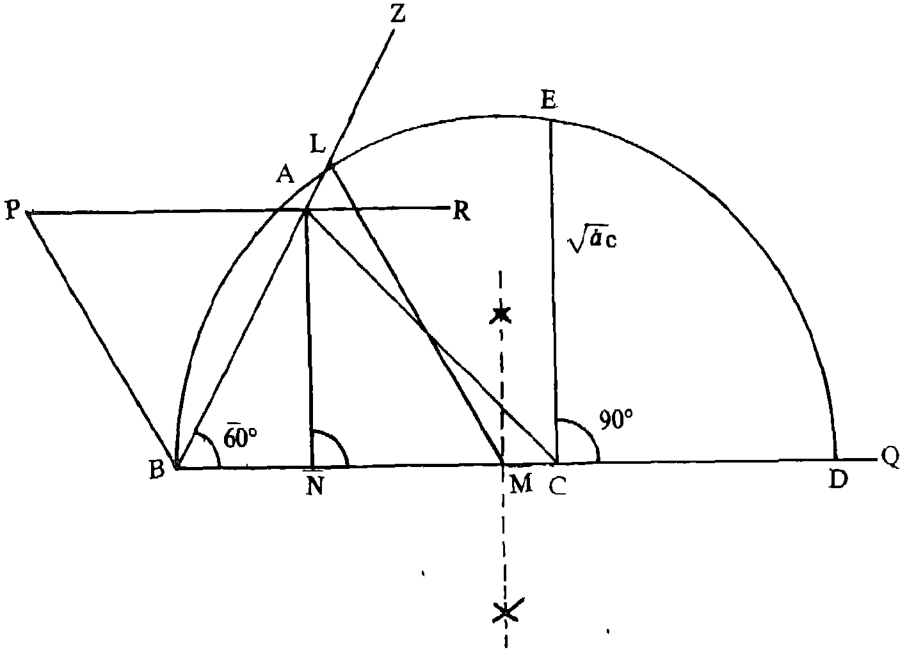
$$=\sqrt{\frac{3}{4}} \times (2x)^2$$

$$=\sqrt{\frac{3}{4}} \times 4x^2$$

And the area of Δ ABC

$$= \frac{\text{Base} \times \text{height}}{2}$$

$$= \frac{a \times h}{2}$$



But in the Δ ABN, AB=C and BN=C/2 and ∠ ANB = 90°

So $AN^2 = AB^2 - BN^2$

$$= C^2 - \frac{C^2}{4}$$

$$= \frac{3}{4} C^2$$

or $AN = \sqrt{\frac{3}{2}}\ C$

Thus the area of Δ ABC = $\frac{ah}{2}$

$$= \frac{a \times AN}{2}$$

$$= \frac{a}{2} \times \frac{\sqrt{3}}{2}\ C$$

$$= a\,C\,\frac{\sqrt{3}}{4}$$

$$= \frac{\sqrt{3}}{4}\,a\,C$$

But in the condition of equal areas of Δ ABC and equilateral Δ LBT

$$\frac{\sqrt{3}}{4}\ ac = \frac{\sqrt{3}}{4}\ 4x^2$$

or $4x^2 = ac$

or $(2x)^2 = ac$

or $2x = \sqrt{ac}$

So the side of equilateral Δ is $\sqrt{ac}$

Reading Achievement in Science

Dr. Marlow Ediger
Professor of Education
Route 2, Box 38
Kirksville
Missouri 63501 USA

Reading in the curriculum area of science is vital. It is a way of identifying problems within the context of reading. Reading can also be an approach used to develop an hypothesis as well as test hypotheses. Reading is a skill that can complement a hand on approach in learning relevant facts, concepts, and generalizations pertaining to different units of study

There are definite methods that science teachers should use to guide student reading in ongoing lessons of study

Guiding Science Reading

I have supervised student teachers in public schools for thirty years and have observed what appears to assist learners to achieve well when engaging in reading activities in science. These student teachers guide learners to be able to identify unknown words prior to their actual reading of subject matter in science Possible new words to be encountered by students in reading science content were printed in neat manuscript letters on the chalk board A few student teachers would print the possible unknown words within a sentence framework. In either case, the student teacher would observe pupils to see that they looked at each word being introduced carefully Sometimes, the student teacher showed a picture or object directly related to the new word printed on the chalk board Meaningful learning is very important Thus, pupils should understand what is read and taught. This was in further evidence when the student teacher had pupils use the new words in sentences If necessary, the student teacher would use the new word in a sentence that would harmonize with the content to be read in the science textbook(s)

Pupils tended to make minimal mistakes in word recognition when the student teacher introduced assumed unknown words to pupils prior to the actual reading of content. I believe strongly that pupils who do well in science tend to be good readers also. If pupils do not read as well as is necessary, They should be assisted by the science teacher to comprehend abstract symbols effectively so that meaningful learning takes place Scientists in a laboratory setting do much reading since this is an important way of acquiring needed information The teaching of science is not a reading course, but pupils need direction to identify needed words so that necessary subject matter can be found in a problem solving situation. When words are introduced to pupils prior to the actual reading of content, learners sometimes make interesting discoveries such as words that are antonyms or synonyms Vocabulary growth the development are important in reading science materials.

Prior to reading science content, the teacher should use pictures or other audiovisual materials to assist learners to secure background information The necessary background information guides pupils to attach meaning to subject matter read. Pupils should not be word callers They must understand what has been read Using visuals or real objects that directly relate to the facts, concepts, and generalizations read will help pupils to understand abstract words encountered I find that learners very frequently identify problem areas when viewing the pictures which make the abstract comprehendible These problem areas then provide reasons for reading. Reading is then done to secure answers/ hypothesis to the identified problems. Additional learning activities will be needed so that pupils develop reasonable hypotheses to problem areas Experimentation should be the heart of the science curriculum with reading subject matter as another related avenue of learning

After learners have completed the reading activity for the designated lesson, they may then pursue follow up experiences Thus, pupils might use seminar methods to discuss in depth the subject matter read as well as the results of other learning activities The seminar stresses depth, not survey learning

Science teachers should always notice the kinds of errors pupils make in reading Diagnosis is then in evidence The following kinds of pupil errors in reading science content should be evaluated by the teacher ·

1 Mistakes made in sound symbol relationships in reading The science teacher might then provide pupils with help in phonics as it is needed to understand content read

2. Weaknesses noticed in pupils not being able to divide words into syllables so that each word is identified in a meaningful manner There are common prefixes and suffixes which pupils may learn to recognize that have much transfer value from one situation to the next, e.g "un" for a prefix and "ful" for a suffix Once a word has been divided into meaningful parts a pupil may almost immediately identify the unknown due to knowing the pronunciation of selected parts e.g not being able to identify the word "uneasy". However, when the pupil divides "uneasy" into component parts, he/she recognizes "un" and "easy". The two syllabus are then blended to pronounce correctly the word "uneasy".

3. Difficulties in using context clues If a pupil does not recognise a word when reading science content, the teacher

should ask learners to provide a word that fits in with the other words in the sentence Too frequently, pupils provide a guess that is ridiculous for the unknown word. Certainly, pupils should provide a word that makes sense in relationship to the surrounding words in the sentence

Higher Levels of Cognition

Pupils should reflect upon subject matter encountered. To reflect requires thought. Thus pupils should think critically pertaining to ideas gleaned When pupils think critically, they separate fact from opinion, fantasy from reality, and the relevant from the irrelevant Learners may also detect content errors while reading Pupils then must reflect upon the subject matter read so that understanding and concentration are in evidence Also, learners will retain content longer if reflection upon ideas obtained is emphasized A good science teacher realises that pupils needs to become good readers since reading is one avenue of learning, among others

Higher levels of cognition also require that pupils think creatively pertaining to ideas obtained With, creative thinking, pupils secure originality of ideas Uniqueness and novelty of response are salient in the creative thinking domain

Problem solving procedures as skills are vital for all pupils to develop. To solve problems, pupils need to be curious individuals who have a desire to learn Reading is one way to obtain necessary information to solve problems. Thus to solve problems, pupils need to identify a problem area, develop an hypothesis, test the hypothesis, and revise the hypothesis if needed In each step of problem solving, learners may read from the science textbook or/and tradebooks, e g , pupils might identify one or more problems in science through reading. Generally, additional learning activities will be in the offing so that pupils may select and solve problems in depth rather than use survey approaches

Conclusion

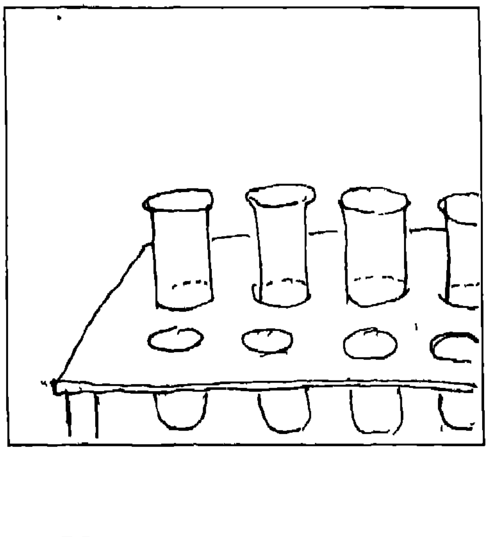
A quality programme of reading in science stresses learners acquiring vital facts, concepts, and generalizations in ongoing lessons and units of study. Reading, along with other activities and experiences, should provide a variety of endeavours to secure pupil interest Various endeavours also guide the science teacher in providing for individual differences in the classroom so that each pupil might learn as much as possible

Reading in science needs to emphasize higher levels of cognition Thus pupils develop skills in critical and creative thinking as well as in problem solving. Learners need to achieve optimally in science The world of science surrounds everyone and has made for inventions and technology that truly are outstanding and revered.

To Explore the Attitudes towards Laboratories and Other Related Practical Work in Science

Ms Alka
T.G.T. (Science)
Sarvodaya Kanya Vidyalaya No. 2
Palam Village, New Delhi

Dr Krishna Maitra
Department of Education
Central Institute of Education
University of Delhi



There is currently an active, lively and constructive debate concerning the nature and style of teaching of science most appropriate to the students in our schools and colleges. Should science concentrate on content or process? Should we provide education in science or educate the pupils through science? Such questions have often been raised in the context of science education. Science now being compulsory for all up to the age of 16, the foregoing questions have become more probing.

Science teaching essentially requires a judicious and careful blending of theory and practical work. Activities and experimental work are an integral part of any conceptual development in science. As Solomon (1980) has said "Science belongs there (laboratory) as naturally as cooking belongs to a kitchen and gardening to a garden". There is no doubt that the practical work always has a prominent place in the teaching of science. *However, the question of its expected role and realities to judge its contribution towards actual achievement need to be addressed.*

Science educators have time and again tried to emphasize the importance of practical work in teaching of science. Efforts have been made to plan the curricula in a way which gives lot of scope and initiative for such activities. Unfortunately, we, have not been able to achieve the goals envisaged through practical based curricula. Some of the plausible reasons for such a situation were delved into, through this study.

For example : What is the opinion of students regarding these activities? Do the teachers conduct these activities simply and effectively? Do these activities have any incentive for teachers and students alike?

Also, this study explore whether the attitude towards these activities is related to gender difference or to the difference in social environments

Unfortunately, researches in the field of science education have so far neglected the attitudes towards practical activities of those people who are supposed to actually implement these ideas into practice So, the present study examined more of the human factors involved in teaching of science than merely the physical aspect of science teaching.

Statement of the Problem

With an aim to investigate the attitude towards practical aspects of science, it is necessary to focus on precise connotation. So the problem is framed as

> ***Attitudes Amongst Students, Teachers and Other Professionals Towards Laboratory and Other Practical Work in Science***

Objectives of the Study

1 To explore the notion of science as perceived by students, teachers and other professionals
2. To examine the specific attitudes of students, teachers and other professionals towards teaching of science
3. To study attitudes towards practical aspects of science teaching of students, teachers and other professionals.
4 To evaluate the effect of attitudes of students and teachers on the students' performance in science.
5. To study the system of evaluation of science in schools.

Nature of the Study

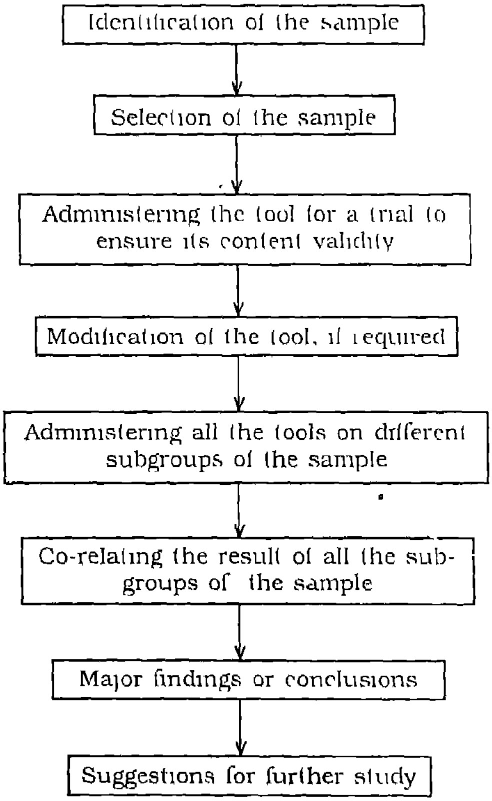
The present study being an exploratory one, the following flow chart is conceived to give a structural view to the research process

The Sampling Design

It consists three phases First phase consists of selecting the representative sample of students, second includes the selection of teachers and third one is that of professionals other than teachers

(i) *Students* . For the purpose of selecting representative sample of students from various stratas, girls and boys from both rural or urban schools

Structural View to the Research Process


Identification of the sample
Selection of the sample
Administering the tool for a trial to ensure its content validity
Modification of the tool, if required
Administering all the tools on different subgroups of the sample
Co-relating the result of all the subgroups of the sample
Major findings or conclusions
Suggestions for further study

were selected.

For pilot study five students from IXth and Xth grades of a local school were selected, though the same students were not included in the final sample.

TABLE 1

Distribution of Sample Population

	Name of the School	No of Students	
		IX	X
1.	Govt Girls C/M Sr Sec. School No 2 Palam Vihar New Delhi	35	30
2.	Govt Girls C/M Sr Sec School No 1 C Block, Janakpuri, New Delhi	31	27
3	Govt Boys Sr Sec School No 2 C Block, Janakpuri, New Delhi	34	44
4	Govt. Boys Sr Sec School No 1 Palam Village, New Delhi	47	48
	Sample size	147	149

Total Sample size = 296 students
No of girls = 123
No. of boys = 173
No of students from rural schools = 160
No of students from urban schools = 136

(ii) *Teacher* : For **the purpose** of selecting a representative sample of teachers, both male and female teachers were selected from rural and urban schools

Also, the sample of teachers was selected from the same schools to which the selected sample of students belonged Only those teachers who were teaching science at IXth and Xth grade were selected so as to validate — both teachers' and students' *viewpoints*.

TABLE 1

Distribution of Sample Population

S No	Name of the School	No. of Teachers
1.	Govt Girls C/M Sr Sec School No 2 Palam Vihar, New Delhi	5
2	Govt Girls C/M Sr Sec School No 1 C Block, Janakpuri, New Delhi	5
3	Govt. Boys Sr Sec School No 2 C Block, Janakpuri, New Delhi	4
4	Govt Boys Sr Sec School No.1 Palam Village, New Delhi	6
	Total Sample size	20

Total Sample size = 20
No. of male teachers = 10
No. of female teachers = 10
No of teachers from rural schools = 9
No of teachers from urban schools = 11

(iii) *Professionals* : To inquire into the viewpoints of the policy-makers who matter, a small sample from this group was also considered

Sample chosen was such that it included personnel working at different positions and belonging to different institutions This has been done to have a broader opinion pools.

TABLE 3

Distribution of Sample Population

S No	Name of institution to which the professional belong	Sex	Designation	Area of Specialisation
1.	Govt Boys Sr Sec. School, No 2, C Block, Janakpuri, New Delhi	M	Principal	Biology
2	Govt. C/M Girls Sr. Sec School No. 1, C Block, Janakpuri, New Delhi	F	Principal	Biology

3	District South West Office, Vasant Kunj Zone 21, New Delhi	M	Education Officer	Physics
4	State Council of Educational Research and Training (SCERT) New Delhi	F	Lecturer	Chemistry
5	Central Institute of Education (CIE) University of Delhi New Delhi	F	Lecturer	Chemistry

Total Sample Size = 5
No of male professionals = 2
No of female professionals = 3

Tools

In the present study, the researchers have developed four tools in accordance with the needs relevant to the objectives of the study

(i) Attitude scale for the students
(ii) Interest inventory for the students
(iii) Questionnaire for the teachers
(iv) Semi-structural interview for other professionals

Procedure for Analysing Data

Analysis of the data will be done in three steps

I. Statistical Analysis

Used for analysing information obtained from attitude scale

(a) Mean (measure of central tendency)
(b) Standard deviation (measure of depression)

II. Inferential Data Analysis

Statistical inferential analysis was applied to estimate intra-variations in the sub-sample of students boys-girls, rural-urban school students and IXth-Xth grade students.

To estimate whether these variations are significant 't' test was used

III. Content Analysis

Content analysis was used by the researchers in order to analyse

(i) Students' responses on inventory
(ii) Teachers' responses to the questionnaire
(iii) Professionals' responses in the interview

The researchers have used semantic analysis of the first level for analysing the data In the case of students' re-

ITEM NO 1(i)
(Science can be fun because .)

TABLE 4

S No	*Categories of responses*	**R/B* IX	X	**R/G* IX	X	**U/B* IX	X	**U/G* IX	X	*Total*
1	What in science makes it fun	59.6	45.8	65.7	43.3	47.0	61.4	45.2	81.5	56.2
2	How it (science) can be fun/manner	-	27.1	17.1	50.0	44.0	25.0	29.0	2.4	24.3
3.	It cannot be fun	12.8	2.1	5.7	3.3	2.9	-	16.1	11.0	6.75
4	Not answered	10.6	10.4	5.7	3.3	-	9.1	9.7	2.4	6.4
5	Ambiguous	17.0	14.6	5.7	-	5.8	4.5	6.4	-	6.75

*R/B stands for 'rural boys', *R/G stands for 'rural girls', *U/B stands for urban boys and *U/G stands for 'urban girls' sponses, the analysis would be at the manifest level whereas for teachers' and professionals' responses analysis would be at the latent level

Two questions from the student's inventory to elicit the responses received by the researchers

This table elicits an interesting aspect

Eighty per cent students have stated positively that science can be fun. Out of those 80 per cent, 24 per cent have suggested method by which teaching science can be made enjoyable full of fun

There are some interesting quotes by the students in response to this item —

"While doing practical we get the same pleasure as in games"

"In every game there is some science".

"Which the laboratory method we can understand science as simple as a game"

"Science can be fun if we are allowed to perform practicals or quizes "

1 Thirty per cent of the student seems to associate science with general awareness of the environment in which they live.

2 Twenty per cent associate science with discovery and inventions that provide us good and comfortable living

3. Fifteen per cent have expressed their interest towards the practical application of science

Some of the quotes by the students are as follows

ITEM NO 2
What is Science

TABLE 5

S.	Categories of responses	*R/B IX	*R/B X	*R/G IX	*R/G X	*U/B IX	*U/B X	*U/G IX	*U/G X	Total
1	Unaware/Not answered	29 8	31 2	-	-	9 7	25 9	-	13 6	13.8
2	Invention/development leading to comfortable life	2 1	18.7	33.3	50 0	2 8	14 8	32 3	13 6	21 1
3	Information or knowledge about things around us	17 0	10 4	22 8	20 0	22 6	14 8	23 5	47 7	28 3
4	Scientific facts to be understood	-	6.25	2 8	-	-	-	-	-	1 1
5	Utility	6 4	12 5	8 6	3 3	2.8	-	14.7	-	6 0
6	General Awareness	10 6	10 4	5 7	10 0	9 7	7.4	14 7	9.1	9 7
7	Practicals make it Interesting	6 4	10.4	20 0	6 7	25.8	22.2	2 9	13.6	13 5
8.	Boring Subject	12.8	-	-	-	22 6	11 1	2 9	2.3	6 5
9	Things to understand	6 4	-	-	-	-	-	2 9	-	1 2
10	Keep us active mentally and physically	2 1	-	2 8	-	2 8	3 7	-	-	1 8
11.	Keep up wholistic view	8 5	-	2.8	10 0	-	-	5 9	-	3.4

*R/B stands for 'rural boys', *R/G stands for 'rural girls', *U/B stands for 'urban boys' and *U/G stands for 'urban girls'

ITEM NO 14

What type of teaching aids do you use in your class

TABLE 6

S No	Categories	*R/B	*R/G	*U/B	*U/G	Total
1.	Black Board	16.7		-	40	14.2
2.	Models/Charts/Specimens	50	-	100	60	52.5
3	Ambiguous (which create interest to study science)	33.3	25	-	-	14.6
4	Improvised daily use things	-	75	-	-	18.75

"Science is a magical subjects "

"It unfolds secrets of life"

"We prefer to be taught by the method of practice teachers"

"Science requires lot of labour "

"Science is a means to understand world better ground you"

Two questions from teachers questionnaire to elicit the responses received by the researchers.

ITEM NO 11

Is there any permanent arrangement in your time-table for practicals?

TABLE 7

S.No	Categories	*U/B	*R/G	*R/B	*U/G	Total
1	No	50	50	40	-	35.0
2.	No with reasons	-	25	40	40	26.25
3.	Yes	50	25	-	40	28.75
4	Not answered	-	-	20	10	7.5

None of the teachers mentioned the use of modern audio visual aids available for teaching, for example like film-strips films, video films, transparencies or use T.V, V.C R , Projectors etc.

It is evident from the table that ·

1 More than 70 per cent teachers have stated that there is no permanent provisions of allotted time for practical

2 Teachers have also pointed to the paucity of facilities and the number of teachers

Summary of Findings

This section has a relevance with respect to objectives of the study.

The researchers after analysis and interpretation of the data collected, have summed up the findings Findings are grouped as per the analysis of the responses discussed above

Students

1 Amongst all the students irrespective of their gender and school, the rural girls of grade Xth reflected very high and positive attitude towards science, in general, and to practical, in particular

2 Overall, the boys seemed to have more positive attitude than girls towards the practical aspects of science

3 Grades do not make any significant difference in the attitudes of the students

4 Content analysis of the students responses reflected their different viewpoints about the nature of science. The girls emphasized the knowledge aspect whereas the boys emphasized the practical aspect of science It was also evident from the analysis that the girls are, in general, averse to learn science because of the non interesting method of teaching Though girls from an urban school specifically mentioned their linking for trainee-teachers who use many aids while teaching, Even the boys expressed the same view

5. As girls associate science to the knowledge aspect, they are not averse to taking notes, whereas the boys expressed their negative viewpoints in this regard A majority here has the feelings that science is fun as it is full of activities which in reality are hardly done. As such they expressed their desire to make science more practical based.

6. Three-fourth of the students opt for science because of their inclination whereas some go by their parental pressure

Teachers

7 Teachers are quite ambiguous in their responses They themselves contradict their own responses and offer a number of reasons for not conducting any practical activities or using aids/demonstrations while teaching In reality they themselves are not very inclined to do so. Interestingly, hardly any one mentioned the multimedia approach for teaching, particularly the modern innovation in science teaching

8 Science being a dynamic discipline, needs constant updating of one's knowledge which is lacking in most of the teachers. When asked specifically about their membership in any scientific organization the answer was a big 'no' from 95 per cent of the teachers.

9 Maximum number of teachers involved in this study fail to show their innovativeness in procedure for evaluating their students

10 Though, all the teachers are familiar with the doctrine of 'learning by doing' they fail to implement this in their own pedagogy when asked 'how will you visualize science without practical' the responses were not only distributing but also contradictory to the premise of learning of science

Professionals

11 The professionals by and large have asserted that teaching of science must include both processes and products which assist in inculcating a healthy attitude towards science and develop the scientific skills of the students thereby resulting in a proper concept formation

12 Professionals have also emphasized that the curriculum should necessarily include numerous practicals— infact they suggest that science classes should be held in laboratories — with adequate periods of time al-

lotted for this activity

13 Unfortunately, from the interview that were conducted with the professionals, the researchers got an impression that there is no cohesive coordination between supervisory agencies that are required to inspect and confirm the implementation of policies laid down by the department of education. Infact it appears that each agency tries to shift the onus to the other

14 Professionals have also emphatically declared that the evaluation procedure for the practicals in the tenth grade should be shifted from internal examination to external examination This they feel will enhance the use of practicals in teaching of science.

15 Professionals are of the view that the seminars which are being conducted by SCERT will definitely go long way in enhancing the skills of the teachers involved with the teaching of science

16. The professionals also feel the need for adopting certain policies whereby the school teachers are imparted precise and adequate training to enable them conduct practical classes simply and effectively

17 Professionals believe that the school teachers, if willing, can teach science through inexpensive and readily procurable articles which they can make use of in simple practicals

Performance

18. The researchers found that boys who showed a more positive attitude towards science as compared to the girls were unable to reflect the same in their performance

20 Teachers attitudes do have an impact on the students attitudes and their performance. As all the female teachers of an urban school have admitted having administrative difficulties in conducting practical classes. This implies no practical work is being conducted in their school. This is also reflected by their students The mean of the scores obtained by them on the attitude scale is least as compared to that of the whole group

A Study of Primary Teachers' Responses to Assess their Understanding of Competency-based Environmental Studies Curriculum Subsequent to Participative Training Programme

DR LALIT KISHORE
Director
Lok Jumbish Parishad
Jhalana Doongri
Jaipur - 302 004

RAJESH KUMAR SHARMA
Sandhan
Education and Development Study Organisation
B-104, Manu Marg, Tilak Nagar
Jaipur - 302 004

With the launching of Minimum Levels of Learning (MLL) approach to improve the quality of primary education, competency-based education is going to be the mainstay henceforth Many educators and primary education project functionaries seem to have hardly any major objections to the competencies laid down by the Dave Committee in 1991 However, some major controversies have emerged regarding implications of the MLLS in environmental studies (Vidya Bhawan Society, 1995) Lok Jumbish Parishad (LJP) a primary education project in Rajasthan made a departure from the competencies laid down in the MLL document of the National Council of Educational Research and Training (NCERT), New Delhi and came out with its own set of competencies drawing its strength from Minimum Level Learning Continuum document of the NCERT and Eklavaya Prashika (1994) programme of Madhya Pradesh

A recently reported (LJP 1996) review of competencies and EVS textbooks of LJP by the Operational Research Group (ORG 1995) brings forth the strengths of new set of competencies over the NCERT propagated competencies in EVS The LJP competencies of EVS include the process-skills (Sandhan, 1995)

Over and above this, the main issue is to relate these to the transaction of EVS instruction effectively in the classroom. According to Jangira (1994), one of the significant aspects of this issue relates to the preparation of teachers to plan and transact EVS related competencies to pupils The teaching-learning methodologies for training the teachers are determined, among other things, by the essential need to transfer skills to improve teaching/learning process in schools so as to ensure proper learning by children.

The training for LJP school teachers is provided by a resource institution called **Sandhan**, which has developed a twelve-day training module along with an interactive cascade model of imparting decentralised participative training to teachers at the Block level ([illegible], 1995). The main requirements of such at training as put forth by Jan[illegible] (1994) are as follows :

- Listening to the participants carefully and with sensitivity
- Sharing thoughts, informations, perceptions and process related to EVS
- Enjoying learning or regarding learning as a pleasant experience There is little evidence that pain inessential condition for learning
- Involving participants in self-study, reflecting and sharing in small groups and inter-group interactions
- The problem solving and inquiry approach should be central to training in an open environment of mutual interaction

The Tbilisi conference on environmental education in schools has rightly recommended the following for effective in-service education of teachers.

- Making environmental education inservice training available to all teachers who need it.
- Understanding of a wide range of educational materials with special reference to low-cost material and providing opportunities for adoptation and improvisation according to local circumstances
- Understanding of environment education curriculum
- Practising pedagogical skills
- Acquiring commitment and conviction about environmental issues, i e , attitudes and sensitivity.

The main emphasis in training has to be on updating and improving the pedagogical skills of teachers. According to Shulman (1987), pedagogical skills can be improved by stressing the development the teacher's ability to reason about the content of instruction The teacher must be able to analyse critically the material he or she wishes to present and explain examples to convey the concepts and adopt the material to the interest and abilities of his or her pupils

About Lok Jumbish EVS Programme

According to LJP fourth report (1995), the highlights of the EVS programme are as follows.

The approach to EVS curriculum has been viewed in LJP as an inter-disciplinary learning area directed towards the development of problem-solving skills and a concern for the environmental realities. This called for a departure from the existing curriculum of EVS in Rajasthan as well as the competencies proposed by the Dave Committee set up by the Government of India. Consequently, an Advisory committee was set up by LJ in February, 1994 under the chairmanship of Shri Komal Kothari with a view to evolve an innovative EVS curriculum at grade Level III

The Advisory Committee deliberated on the nature of EVS curriculum. Drawing on the experiences of other innovative programmes, the committee made the following recommendations :

- The EVS curriculum under LJP be process-based, activity-oriented and competency-based and the learning areas and competencies be reframed to fulfil these requirements
- Care be taken that curriculum helps the child in recognising values and

clarifying concepts so as to develop in him or her the skills and attitude necessary to understand and appreciate interrelatedness between human beings, their culture and the biophysical surroundings

- Efforts be made to give a proper place to the following in the EVS curriculum
  - folk culture and arts of Rajasthan
  - environment-oriented productive work, and
  - health and population education.
- An expert group be formed to develop an EVS textbooks for Class III for tryout in 45 schools of Arain Block before its extension to other classes and Blocks.

For curriculum development and textbook preparation, and eight member Expert Group consisting of subject experts, educators and teachers was formed The group was asked to identify the learning areas and competencies within the framework of the recommendations made by the Advisory Committee The Expert Group met thrice in March and April, 1994 and identified twelve learning areas and prepared a draft statement of competencies to be developed. These competency statements were reviewed in a workshop with teachers in April, 1994 and redrafted to make them more relevant and local specific In April, 1994 itself, another workshop was organised to evolve a format of the EVS textbook This was followed be a month long process of writing and reviewing the units for the textbook. The first draft of the textbook was ready by the end of May, 1994 which was reviewed during the training of master trainers and later during the twelve day teacher training programme

The final draft was prepared after review of the textbook at these three levels. The EVS textbooks titled — *Khoji Pothi* (meaning Discovery Book) was published in June 1994 and introduced in 45 schools of Arain Block with effect from the session, beginning July 1994.

The basic premise of Khoji Pothi is that the child is curious by nature and has an innate capacity to explore and learn from the immediate environment Hence, while writing Khoji Pothi efforts has been to ensure that its transaction in and out of classroom enhances the child's capacity to explore the local environment and lean from it Also, equal emphasis has been given to both the process and content of learning. The process part has activities mainly revolving around the following aspects,

> making observations, recording observations, classifying observations, recognising patterns and relationship, hypothesising, verifying, producing experimenting, drawing conclusions, making things, and doing environment-oriented productive work.

Efforts have been made to make the content part interesting by the use of illustrations, picture reading exercises, story-narrative techniques and information-processing exercise *Khoji Pothi* has been formatted as a textbook-cum-workbook to enhance the learner-material interaction.

The new EVS curriculum was introduced in July, 1994 after twelve day training of 130 teachers of two clusters of Rain Block. In all four training camps were held with the help of 5 master trainers and six resource persons from Sandhan. Besides, the resource support of Cluster Resource Team and Block Resource Team, a team from Sandhan visited the schools to get the feedback for revising the textbook for the next academic session. Also, two (2-day) mid-session workshops were organised by Sandhan for getting feedback from teachers One of the main reasons for organization of these workshops was to benefit from teachers' perceptions about the textbook

Objective of the Study

The objective of the present study can be stated as : To study the responses of teachers of a Block in the state of Rajasthan, regarding their understanding of the competency-based EVS curriculum making use of process-skills during their participative in-serving training.

Methodology

Eighteen primary teachers drawn from 18 rural schools of Jhalarapattan Block Jhalawar district in Rajasthan constituted the sample. The average qualification of teachers was graduation and all of them had received their pre-service training The mean of age and teaching experience was 34 years and 8 years respectively.

The twelve day training was residential in nature. The methodology of training was basically participative, group discussions and group work were the two major training processes

The total number of training hours devoted for EVS were 12 and this time was split into the following sessions -

- EVS . What, why and how ?
- Understanding EVS competency statements
- Hard sports of EVS in previous classes
- Horizontal and vertical linkages among competencies
- Identifying competencies in the lessons
- Role of teacher in EVS curriculum transaction
- Demonstration lessons
- Concept attainment.

Another two important features of the in service training were the daily review of the training by the participants followed by a meeting of the core group to affect a mid-course correction by the resource persons who mainly functioned as facilitators In all, two resource persons were available for EVS training while the daily follow-up meeting discussed the strength and weaknesses of the session. The meeting usually lasted for about two-hours everyday. Everyday the participants presented their review in a variety of modes, viz. in the form of role play cartoons, wall magazine, narrative report, poetry etc

After the training, the participants were asked to give responses to the following five questions.

1. What difference do you find in the existing EVS curriculum and the new curriculum?
2. Why is it necessary to sharpen the observational skill of children?
3. What opportunities will you provide for sharpening the observational skill of children?
4. What competencies/abilities would you like to develop among children through EVS curriculum?

5. Write any five specialities of new EVS curriculum

The understanding of participant about EVS curriculum was evaluated by three experts on three point scale The analysis of the data so collected was done using chi-square technique to draw conclusions

Data Collection and Analysis

The data was collected on a separate sheets which consisted of descriptive responses. Some of common responses of the participants were :

1. Earlier, EVS curriculum was heavy for the child and beyond his developmental level. The new curriculum is light and activity-based The new curriculum provides the aim of each lesson in the form of competency
2. Observation is the base for making a sense of the world. Sharpening observational skill will develop curiosity of the child. Observation also means providing direct experiences which leads to better understanding of concepts
3. The opportunities that can be helpful to sharpen observational skills are. learning by doing; providing challenges to explore, encouraging children to do self-learning
4. The competencies which can be important for EVS curriculum can be: raising questions; doing experiments, discovering; thinking, logic making things, decision making value-orientation, imagination; and creativity.
5. The new curriculum is based on discovery approach consisting of activities, simple and interesting reading material, developing competencies, self-learning, and pedagogical principles

Some of the unfavourable responses of the participants are given below .

1. Although the illustrations given in the new EVS textbook are many but these are not of good quality.
2. There is less content or theory in the new text book which is contrary to the age of knowledge explosion.

The response sheets were further analysed on the three points scale by three experts who had developed the process-based curriculum. The three-point scale was as follows .

Good understanding/response = A
Average understanding/response= B
Poor understanding/response = C

The weighted scale points were given after taking the mean of individual scores of participants given by three experts. The data on participants, responses is summarised in the following table

TABLE 1

The experts' evaluation of understanding of participants about EVS curriculum (N = 18)

Experts	*level of understanding*		
	A	*B*	*C*
I	6	9	3
II	5	10	3
III	6	8	4

From the above table, the observed and expected frequencies were calculated which have been depicted in Table 2.

TABLE 2

Summary of experts' evaluation of understanding of participants about EVS curriculum (N=18, D.F. = 8)

Expert	*Frequency of level of understanding*						*Chi-square*
	A		*B*		*C*		
	O	*E*	*O*	*E*	*O*	*E*	
I	6	6	9	6	3	6	
II	5	6	10	6	3	6	10 1*
III	6	6	8	6	4	6	

* Significant at 0 05 level

Conclusions and Discussion

When done in participative mode, the teacher training programme produced the understanding of competency-based EVS curriculum at 0.05 level of significance Though there are hardly any studies regarding the participative training, none-the-less, there are many advocates for such kind of training (Agnihotri, 1994, Lok Jumbish, 1995 and Sandhan, 1995).

There is a need to format teacher training in the participative mode. Kishore (1993) suggests that along with participative training, it has to be reflective too The fundamental aspects of effective teacher orientation programme (Agnihotri, 1994) are as follows :

1. Creating an awareness of the learning process and bring about attitudinal changes.
2. Cultivating skills and confidence.
3. Helping teachers to acquire knowledge.
4. Developing those operational skills that are needed to put curriculum into practice.
5. Helping teachers in a sense to become their own informal researchers.

Thus, sincere efforts need to be made to being about equality between resource persons and teachers There is a need for intensive full-time interaction during the day, both inside and outside the training site. Agnihotri et al. (1994) further states that it is not only difficult to convince teachers that they know a lot from their experience and knowledge, it is equally difficult to convince resource persons that they may have something to learn from the teachers.

Thus, residential participative training hold a good promise in developing understanding about curriculum and its transaction. As such, training should develop relationships between the resource persons and trainees which are far more important than mere conduction of training programmes in a routine fashion.

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REFERENCES

1. Agnihotri, R K et.al. Prashika: Eklavya's Innovative Experiment in Primary Education, New Delhi Ratna Sagar Pvt. Ltd. 1994

2. Lok Jumbish; The Fourth Report (Jan , 94 Mar., 95) Jaipur· Lok Jumbish Parishad, 1995
3. Lok Jumbish, The Fifth Report; Jaipur Lok Jumbish Parishad, Jan, 1996
4 NCERT, Minimum Levels of Learning, New Delhi National Council of Educational Research and Training, 1992
5. ORG, Evaluation of NFE Programme, Lok Jumbish Project, Jaipur Lok Jumbish Parishad, 1996
6. Sandhan, *Barah Diwsiya Shikshak Prashikshan Module*, Jaipur· Sandhan 1995
7. Vidya Bhawan Society, Report of the Seminar on Environmental Studies, Udaipur· Vidya Bhawan Society, 1995

A Study of the Attitude of Secondary School Science Teachers Towards Teaching of Science

A.K NAIK
Research Scholar
A E.S College
Tarbha, Sonepur
Orissa

DR. M K PATHY
Sr Lecturer
Dr. PMIASE, Sambalpur
Orissa

Each and every individual is dependent on science today All activities in our lives are associated with and are governed by science Education is the main instrument for social change and the teachers had to play a vital role in the educational system. Among various objectives of teaching, having positive attitude towards science and developing scientific temper have been emphasised in the core curricular areas of the new education policy. Equally important are the knowledge and attitude of the science teachers If the teachers do not possess scientific temper and proper attitude towards teaching of science, the efforts made to achieve the goals of education are not likely to yield desired results

A review of related literature shows "manipulative skill in teachers and they do not have scientific attitude and proper knowledge about the latest happenings around the world", Rao 1990. In another study Krishna Gopal (1992) had a contradictory finding He found that both male and female teachers teaching science had favourable attitude towards science Male teachers expressed more favourable attitude towards science than the female teachers Keeping in view these contradictory findings, this study had been undertaken for a further probe to find out the attitude of secondary school science teachers towards teaching of science in the schools of Orissa

Objectives

The objectives of the present investigation were·

1 To study the attitude of secondary school teachers in general
2. To study the difference, if any, in the attitude of urban and rural science teachers towards teaching of science
3 To study the difference, if any, in the attitudes of male and female science teachers towards teaching of science

Hypotheses

The following hypotheses had been formulated in connection with the study

1. The teachers in general would be having positive attitude towards teaching of science
2 There would be no significant difference in the attitude of urban and rural science teachers towards teaching of science
3. There would be no significant differ-

ence in the attitude of male and female science teachers towards teaching of science.

Attitude is a term defined by Allport (1935) in sixteen ways on the basis of preparation or readiness for favourable or unfavourable response which is organised through experience and activities in the presence of all objects and situations with which the attitude is related. According to him attitude has five characteristics such as emotion, consistency, target, direction and intensity Keeping in view these characteristics an attitude scale was developed in the liked method. At the outset servanty statements (both positive and negative) were formed Then it was administered on a mixed sample of forty urban and rural secondary school science teachers of the district of Bolangir in the Western Orissa However, the sample comprised 20 male and 20 female teachers from all types of schools, viz, government aided, unaided and TRW Finally only 36 items were selected having 19 highly positive and 17 highly negative items The reliability of the scale was found to be satisfactory under the test-retest method. The co-efficient of co-relation was found to be 0.70. The content validity of the sample was found to be satisfactory by referring it to a panel of experts The attitude scale was finally administered through out the state of Orissa by stratified random sampling procedure The data was analysed by applying the statistical techniques of simple mean, standard deviation and critical ration

Presentation and Analysis of Data

The description of the sample the teachers associated with the study, and the analysis of their responses to the questionnaire are as follows .

TABLE 1

Description of the Sample

			Number	Percentage
(a)	Sex	Male	186	72/65
		Female	70	27 34
		Total	256	(100)
(b)	Area	Urban	83	32 42
		Rural	173	67 57
		Total	256	(100)
(c)	Age	up to 30 years	73	28.51
		31 — 45 years	134	52 34
		46 years and above	49	19 14
		Total	256	(100)
(d)	Educational Qualification	I Sc	10	3 90
		B Sc	222	86.71
		M Sc	24	9.37
		Total	256	(100)
(e)	Training Qualification	B Ed	220	85 93
		M Ed	25	9 76
		Ph.D	00	0 00
		No. Response	11	3 90
		Total	256	(100)
(f)	Teaching Experience	upto 10 years	125	48 82
		11 to 20 years	75	29 29
		21 Years and above	56	21 87
		Total	256	(100)

From the Table 1 it can be seen that the total number of general science teachers in the sample was 256. Out of them 72 65% were male and 27 34%

were female, 32 42% of them belonged to urban areas and 67 57% belonged to rural areas As regard to their age 28.51% were upto 30 years of age, 52 34% were in between 31 to 45 and rest 19.14% were above 46 With regard to their educational qualification 3 90% were I Sc , 86 71% were B Sc and 9 37% were M Sc with regard to their professional training 85 93% were B.Ed., 9 76% were M Ed , and 3 90% did not give any response As regards the experience of teaching, 48 82% were having 10 years of expenence , 29 29% were in between 11 to 20 and 21.87% were above 21 years of teaching experience. Also it was found that only 3.51% science teachers had attended the science exhibition upto ten time at the State level and only 18 75% had attended a seminar or a workshop on science

The mean, standard deviation and critical ratio of the sample are presented in Table 2

TABLE 2

Statistical Analysis of the Attitude Score

Sl No	*Group*	*Number*	*Mean*	*S D.*	*C R*
1	Urban	83	74 32	4.43	4 91*
2	Rural	173	72.65	4 54	
	Total	256	73.23	4 71	
3	Male	186	72 86	4.47	
4	Female	70	74.14	4.45	1.84*
	Total	256	73 23	4.71	

• Significant at 01 level

From the Table 2 it is found that the general mean attitude was found to be 73 23 where the median value was calculated and found as 73 38 more than the mean value

The following conclusions were found and presented below .

(1) In general the mean value was found in the teacher sample as 73 23 where as the median value was found to be 73 38. Hence it appears that in general the science teachers of Orissa have positive attitude towards teaching science This finding is corroborated by the findings of Krishna Gopal (1992)

(2) From the Table it is found that the difference of mean between urban and rural teachers was found to be significant at 0 01 level Hence the hypothesis number 2 may be rejected and concluded that the urban secondary school science teachers have more favourable attitude towards teaching of science than rural secondary school science teachers

(3) From the Table it is also found that the difference of mean between the male and female teaches was significant at 0 01 level Hence the full hypothesis number 3 may be rejected The female science teachers have a significantly positive attitude towards teaching of science than their male counterparts.

Suggestions for further study · The findings of the study shows a supremacy of the urban teacher and female teacher in having a positive attitude towards teaching of science The reasons behind such a phenomenon may be studied separately Further, the role of teaching climate in schools may be studied in developing attitude of teachers

REFERENCES

1 Best John, W *Research in Education* (4th Ed), Prentice Hall of India Pvt Ltd, 1983, New Delhi.

2 Buch M.B Second Survey of Research in Education, NCERT, 1979, New Delhi

3 Buch M.B Third Survey of Research in Education, NCERT, 1987, New Delhi

4 Ediger Marlow *Restructuring the science curriculum* School Science, Vol. XXXIII, No 4, 1995

5. Husen Torsten, *The International Encyclopaedia of Education* Volume I, Preface A.B Pergamon Press, Oxford, New York, 1985 pp 352

6 Krishna Gopal D *Attitude of teacher towards science - A study* The educational review, Vol XC VIII No.12, 1992, p 211

7 Nicholls Howard and Audrey, *Developing Curriculum Practical Guide*, New Ed George Allen and Unwin Publishers, Ltd, 1992-78

8. Rao, Bhaskar D *Science Education in Secondary Schools, A reflection* Experiments in Education, Vol XVIII, No 6, 1990, p 63

9 Taylor Philip H *How Teachers plan their courses*, National Foundation for Educational Research in England and Wales, 1970.

Science Feature

Vaccines from Plants near Commercial Production

DAVID WELSH
LPS Industry and Science Editor

UK scientists developing a technique to produce medically useful peptides and proteins in plants and extract them to create vaccines and therapeutic products believe the system is nearing availability for commercial production. The Chimaeric Virus Particle (CVP) platform technology, patented by Axis Genetics, produces oral human and veterinary vaccines and immunotherapeutics from plants. It is now entering a new phase of development at the Cambridge laboratories where the company, a world leader in this field, is poised to expand its peptides pipeline, based on the genetic engineering of plant virus particles.

The technique involves inoculating young plants with a chosen plant virus which has been modified by genetic engineering to express immunologically active peptides on its surface Left in heated rooms for 21 days, the modified virus multiplies in the growing plant to produce high yields of virus particles which are relatively easy to extract, and each of these bears multiple copies of the peptide or protein of interest on its surface Once purified, these can be used as a conventional injectable vaccine.

Axis Genetics is now beginning to scale up procedures for extracting and purifying the CVPs produced in the leaves of the plant ' crops' in preparation for clinical trials

According to Axis, the genetic engineering of plant viruses to present immunologically active peptides in this way is a 'quantum leap' and the company expects a wide range of novel human and veterinary health care products to result within the next decade The fact that the virus particles expressed by the plants are stable at body temperature and survive both exposure to acid and digestive enzymes also opens up the exciting possibility of their eventual use as oral vaccines

Such a breakthrough could transform vaccine delivery; purified particles could be administered orally or plant material containing particles could be used as the basis of a range o[illegible] lible vaccines against life - threatening or disabling diseases.

Axis has already concluded a number of research agreements Negotiations are also well advanced for strategic alliances with several major pharmaceutical companies which are keen to unlock the potential of their own promising but undeveloped peptides for the first time by harnessing the novel Axis CVP platform technology

Among current collaborations, research with the Institute of Animal Science and Health in the Netherlands and The State Veterinary Institute for Virology in Denmark on parvovirus, an important disease of domestic dogs and cats, is making significant progress. A project with Britain's Institute of Animal Health on the Foot and Mouth Disease Virus (FMDV) that affects agricultural livestock offers another strong prospect of success This work is designed to produce a vaccine which does not use the live virus itself, thus completely eliminating the major danger of disease outbreaks caused by the present FMDV vaccines

Research is also underway with Warwick University on a novel approach to an AIDS vaccine. Designed to give protection against variants of the HIV virus, this is based upon a mixture of several types of viral particles, each of which is designed to stimulate the immune system to produce antibodies These are designed to protect against variants of the HIV virus

Fungal Infections

In the area of immunotherapy, Axis is working closely with the Loyola School of Medicine in Chicago on a novel way to combat fungal infections This is a particular problem for AIDS patients and those receiving chemotherapy for cancer The new approach is likely to be compatible with existing treatments which currently tend to be only partly effective Other work with the University of Oxford covers new research work on an immunotherapeutic approach to the treatment of colon cancer

The patents held by Axis for CVP technology are expected to dominate world production of peptides and proteins as chimaeric plant virus particles One form of the technology, known as EPICOAT, was initially developed by Purdue University in the United States and the UK's John Innes Centre A small part of a foreign protein (a peptide) is inserted into a virus in such a way that it remains exposed on the surface of the particle The exact point of insertion is crucial if the virus particles are to assemble correctly and the virus to replicate normally while the peptide continues to be exposed on its surface

By altering an otherwise natural virus, specific host plants can be used to propagate large quantities of CVPs Current developments centre on the cowpea mosaic virus which infects the cowpea plant of ' black-eyed' bean, the shape of which can accommodate 60 copies of the peptide.

OVERCOAT Technology — the use of the CVP technique with rod — shaped plant virus particles — was invented by scientists at the Scottish Crop Research Institute and enables much larger polypeptides or proteins to be presented CVPs have been produced which present over 1,000 copies of proteins of at least 350 amino acids in size The technology has potential for producing certain vaccine types and also for producing pharmaceutical or industrial proteins

Axis is currently seeking partners for the commercial exploitation of CVP technology in both veterinary and medical applications

Courtesy . SPECTRUM

Objective Type Questions on Periodic Table

Dr K.K. Mishra
Homi Bhabha Centre for Science Education
Tata Institute of Fundamental Research
V N Purav Marg, Mankhurd
Mumbai 400 088

Choose the correct answer :

1. The most abundantly occurring metal in the Earth's crust is
(a) aluminium (b) iron
(c) tin (d) titanium

2 Which of the following elements has the highest density ?
(a) tungsten (b) osmium
(c) tin (d) molybdenum

3. The metal having the lowest density is
(a) lithium (b) cesium
(c) cobalt (d) aluminium

4. Which of the following metals is used for making bulletproof alloy steel ?
(a) Zirconium (b) titanium
(c) yttrium (d) cesium

5. Which of the following metals is used in making high - speed tools ?
(a) tungsten (b) iron
(c) manganese (d) tin

6 Which of the following triplets of metals is called 'coinage metals' ?
(a) iron, copper, cobalt (b) tin, copper, silver (c) gold, copper, nickel
(d) copper silver, gold

7. Which of the following triplets of metals is known as 'noble-metals' ?
(a) palladium, silver, gold (b) copper, silver gold (c) osmium, iridium, platinum (d) silver, gold, platinum

8 The only transition metal which is artificially produced is
(a) scandium (b) titanium
(c) vanadium (d) technetium

9. Which of the following metals is most ductile ?
(a) aluminium (b) copper
(c) silver (d) gold

10 Which of the following has the highest melting point ?
(a) carbon (b) gallium
(c) tungsten (d) osmium

11 Which of the following is the most harmful radioactive element ?
(a) uranium (b) radium
(c) francium (d) plutonium

12. Which one of the following metals is used in making surgical instruments?
(a) titanium (b) nickel
(c) rubidium (d) cobalt

13 Which of the following metals has the highest melting point ?
(a) tungsten (b) gold
(c) ruthenium (d) rhodium

14 The element which has the highest number of isotopes is
(a) hydrogen (b) uranium
(c) thorium (d) xenon

15. Which of the following elements has the least number of isotopes ?

(a) hydrogen (b) carbon
(c) radon (d) oxygen

16 Which of the following isotopes is used in radiotherapy?

(a) cobalt - 60 (b) uranium - 238
(c) deuterium (d) oxygen - 16

17 Which of the following metals is mainly used in making marine equipment because of its corrosion - resistant property?

(a) lithium (b) titanium
(c) vanadium (d) nickel

18 Which of the following has the lowest melting point?

(a) helium (b) fluorine
(c) krypton (d) astatine

19 In addition to diamond and graphite which of the following is the natural and pure form of carbon?

(a) cis - platin (b) coke
(c) azulenes (d) fullerenes

20. All radioactive elements have the natural tendency to disintegrate and get converted into

(a) lead (b) uranium
(c) thorium (d) plutonium

21 The most abundant element in our universe is

(a) oxygen (b) carbon
(c) hydrogen (d) nitrogen

Answer

1 a 2.b 3 a 4 a 5 a 6 d 7.d 8.d
9.d 10 a 11.b 12 d 13.a 14 d 15a
16 a 17.b 18 a 19 d 20.a 21.c

Science News

Dolly — A Wonder Sheep

A team of scientists at Roselin Institute, Scotland disclosed in February 1997 that they have been successful in cloning a sheep, a feat which many biologists had believed to be impossible A clone is a genetically identical replica of an organism which is derived from a single parent by non-sexual method. A clone is, thus identical with its parent both physically as well as genetically. In other words, it mean that a clone has all its chromosome identical with its parent which is not true in the case of natural offspring The sheep, christened as Dolly, is the only mammal in the world not produced by the fusion of the sperm and the egg, the way the natural and traditional reproduction takes place in the animal world. At the time of reporting Dolly was seven month old

As a technique, cloning has been known for many years In fact, horticulturists have been cloning plants by just planting a twig from a parent plant to obtain an entire tree The word clone is, in fact, derived from a Greek word meaning 'twig' In the case of animals also the technique of producing identical twins by splitting a fertilized embryo and then planting them in the womb of surrogate mothers has been developed for quite some time This technique has been successfully used for improving the breeds of milk yielding animals An Australian team has recently claimed to have developed a technique which would make it possible to fertilize eggs of a high yielding breed of cow with a prized bull's sperm and then produce hundreds of identical offspring

However, the technique developed for cloning of Dolly at the Roselin Institute is a marvel of genetical engineering and it is quite different from the earlier techniques. The science behind the new technique of cloning has been acclaimed as a breakthrough because it is for the first time that a mammal has been created from non-reproductive tissues of an adult animal Dolly the sheep, is a clone in true definition of the term because her DNA comes from a single cell taken from her mother's udder which was fused with an unfertilized egg from which the nucleus has been removed The fused cell was persuaded to divide to form an embryo that was implanted into a surrogate mother, where it matured into a healthy sheep

Attempts for developing techniques of cloning have been going on since 1950 The biggest achievement in cloning Dolly over earlier attempts lies in the choice of the cell to be taken from the udder The cell taken from the udder has been exactly in the same stage of its lifecycle as the egg in which it was transplanted. Through a special process the cell was kept alive while its growth was stopped This process compelled the adult udder cells to switch off the factors which make them grow as the cells of the udder. Thus, they were readied to be reprogrammed to a stage which could be called an infancy stage under the influence of the egg cell Thereafter, it followed the natural course

The disclosure about the cloning of Dolly' has once again opened up the debate on many ethical issues. Questions are being raised whether the human being should interfere with the natural processes concerning living beings. Will cloning of human beings be the next in the agenda ? In what way such interference with the nature will affect the living world, in general, and human beings, in particular ? However, many scientists believe that the development of technique for cloning higher animals including human beings may not be feasible in near future The basis of this line of thinking appears to be the fact that cloning of Dolly could be possible only after nearly 270 unsuccessful attempts The main reason for this had been the problem faced in selection of appropriate cell at the correct time of its lifecycle In higher animals this step may pose even greater challenge because not only the growth patterns but complexities in the process also vary widely in the higher group animals

Whatever be the ethical issues involved, the cloning of Dolly is a significant step towards understanding at molecular level the basic processes involved in the growth of living organisms

AIIMS Develops a Special Kit for Indian HIV Patients

A team of scientists comprising Dr Pradeep Seth and his research associate Mohammed Najeeb Siddiqui in the Department of Microbiology, All India Medical Institute of Medical Sciences (AIIMS), New Delhi have developed an indigenous test kit for all the prevalent HIV antibodies to the Indian population The enzyme linked immuno-sorbent assay (ELISA) kit is claimed to be 100 per cent sensitive as it can detect all virus sub-types that are present in the Indian population

According to its inventor Dr Seth the kit has been developed after intense research and a series of experiments speared over a period of two and a half years It has undergone more than 1000 laboratory trials and nearly 500 field trials and has successfully detected the HIV virus in almost all cases. At present two types of HIV — type 1 and 2 are prevalent in patients in India of which the former is the deadliest and more widespread There are sub types A to H and O While the sub-type B is more widespread in western countries, sub-type C is predominant in India The kit has been able to detect all the sub-types.

The laboratory cost of the new kit is approximately Rs 7 00 as compared to the imported kits which cost about Rs 17 50 each. It is envisaged that the development of this kit will enable the government to save huge sums of foreign exchange which it has been spending on the import of HIV testing kits At present, the government imports more that one million unit test kits and the number is likely to increase substantially in coming years as the surveillance for AIDS gets increased

Plastic Lung Offers a New Hope

A significant breakthrough has been made by a team of British scientists in developing an artificial lung made of plastics. Although implantation of such a lung in human beings may take another five years, a breakthrough has been achieved by successfully implanting a plastic lung in a pig and keep it alive for nearly 24 hours. In the next stage of development, it will be tried on a sheep which is expected to be the final step in preparation for its trial on human beings.

The artificial lung of the size of a portable CD player is of the shape of a box containing a lattice of porous fibre tubes It be inserted into the chest cavity so that it can force the blood through the porous fibre tubes which carry oxygen from a tank from outside the body of the patient The oxygenated blood is then again pumped back into the body. However, the problems concerning blood clots and rejection of the system by the immune system of the body are still to be tackled Another inconvenience the patient has to bear with is that he or she will have to carry the oxygen tank wherever he or she moves The advantage this artificial lung is to offer is that the patient need not be confined to hospital bed while waiting for a donor for transplantation of the lung

Launching of INSAT - 3 Series Scheduled in 1999

The Indian Space Research Organisation (ISRO) has made an announcement about the third generation communication satellite programme — INSAT -3 Five satellites under third generation INSAT will be launched between 1999 and 2003

The launching of the first two satellites, INSAT-3A and INSAT -3B would be done through launch vehicles of other countries. The launch of the three other satellites, INSAT -3C, INSAT -3D and INSAT -3E , would depend on the success of test flight of the geo-stationary launch vehicle (GSLV)

According to ISRO chairman K Kasturirangan, Preliminary Configuration for Insat-3 communication satellite programme had been finalised after the definition phase.

The launches of INSAT -3C onwards could be carried out by indigenously developed launch vehicle GLSV provided the rocket gave a satisfactory result in its first three developmental flights These satellites would have similar configuration to that of INSAT -2 series

These satellites will have transponders for expanded coverage, India coverage and KU-band transponders for intra-city coverage and satellite news gathering, and search and rescue payloads It would generally be of the 2,500 kg class weight and have a power range of 2 3 kw

Galactic Cloud of Antimatter Discovered

NASA's Compton Gamma Ray Observatory (CGRO) have discovered two unexpected clouds of antimatter in the Milky Way Galaxy which scientists call "antimatter annihilation radiation" Scientists from Northwestern University, Evanston, IL, the Naval Research Laboratory (NRL), Washington, DC, and other institutions used CGROs Oriented Scintillation Spectrometer Experiment (OSSE) to make the discovery. It indicates to the existence of a hot fountain of gas filled with antimatter electrons rising from a region that surrounds the centre of the Milky Way galaxy. The nature of the furious activity producing the hot antimatter-filled fountain is still not clear, but could be related to massive star formation taking place near the large black-hole at the centre of the galaxy Other possibilities include winds from giant stars or black hole antimatter factories

According to the researchers the maps of gamma ray sources from CGRO show the existence of a large cloud of antimatter near the galactic centre and along the plane of the galaxy. The maps, surprisingly, also show a second cloud of antimatter well off the galactic plane. The second cloud may be caused by the explosions of young massive stars A number of theories has been proposed to explain the mystery behind the origin of this new and unexpected source of antimatter. The antimatter cloud could have been formed by multiple star bursts occurring in the central region of the galaxy, jets of material from a black hole near the galactic centre, the merger of two neutron stars, or it could have been produced by an entirely different source, according to James D. Kurfess, Head of the Gamma and Cosmic Ray Astrophysics Branch at the Naval Research Laboratory

Dr Charles Dermer and Dr. Jeffrey Skibo of NRL have observed that the gamma-ray observations enabled them, to see clearly, for the first time, a new part of our galaxy made of a hot column of gas filled with antimatter electrons (also called positrons) In their opinion the antimatter electrons come from newly created elements produced by exploding stars formed near the centre of our galaxy

Evidence points to the existence of a black hole with the mass of a million Suns at the very centre of our galaxy Unlike in other galaxies which harbor huge black holes, very little light comes from this source Huge dense clouds of gas also surround the galactic centre. Prolific star formation, powerful stellar winds from massive stars, and supernovae are all found here Another theory, based on observation of radio ;emissions showing some black holes produce X-rays and jets, is that such outflowing jets could be made of antimatter

The Compton Gamma Ray Observatory, launched from the Space Shuttle in 1991, views the universe in a search for gamma rays and their source. Gamma rays are extremely energetic light photons produced by high-energy particles, by the decay of excited nuclei, and when matter and antimatter annihilate each other. Antimatter cannot be found in large quantities on Earth because it would instantly vaporize anything it came into contact with All evidence points to the universe being composed almost entirely of normal matter, though opinions differ on this. Using the OSSE experiment, the OSSE team found antimatter positrons to be annihilating with normal matter electrons at an astonishing rate Scientists are speculating on the origin of this antimatter, with a "black -hole lobby" favouring antimatter production in the jets of black holes

Other scientists favor freshly synthesized radioactive material in stellar explosions being ejected up above our galaxy in an annihilating fountain of gas Drs Dermer and Skibo favor the latter scenario, because exploding stars will eject, large quantities of hot gas made up of normal matter. This hot gas provides a target with which the antimatter electrons can annihilate

Whatever the true situation, a hot gas appears to be heated and blown out from the region near the centre of our galaxy This antimatter-filled gas traces a new feature of our Milky Way, essentially unknown until now Activity hidden behind vast clouds of dust and gas can be seen in the light of its gamma radiation, giving a new view of our home galaxy.

BARC Develops a new Technique to Desalinate Brackish Water

The Bhabha Atomic Research Centre (BARC) has developed a new technology to desalinate brackish water The technology offers a hope for solving the problem of drinking water in scarcity hit areas as also on the ships which remain in the sea for a long time The technology is based on "reverse osmosis" technique but is likely to be quite cost effective as compared to the technology available at present It is capable of desalinating about 30,000 tonnes of brackish water in one day

The BARC technology is based on the tubular and plate module configuration and has the capacity to desalinate brackish water containing up to 10,000 ppm of undissolved solids The technology can also be made applicable in solving other major problems like the treatment of effluent water, sewage and industrial waste water

It has been worked that plant utilizing this technology can be set up at affordable costs to meet the potable water needs of suburbs of metros like Mumbai and Delhi It will save the cost of laying pipelines as well as the cost of pumping water through long distances because the ground water available near urban habitations can be made potable by this technology even if it has a high salt concentration

The technology promises to make sufficient portable water available in areas like Gujarat and Rajasthan where water scarcity keeps the population especially women occupied for entire day in fetching water from large distances.

Why the Heart Stops Pumping: Cellular-Molecular Defect in Heart Failure Identified

Untreated high blood pressure is the main cause of many a cardiovascular disease, including enlargement of the heart, heart failure, arrhythmias and stroke It is a leading cause of death world over When high blood pressure persists untreated, it enlarges he cells of the heart and produces a silent defect in the heart's pumping mechanism, according to a team of researchers headed by Prof W Jonathan Lederer, Head of the Department of Molecular Biology, at the University of Maryland School of Medicine and Medical Biotechnology Center in Baltimore, U S.A

Although the enlargement of the heart cells may appear as a beneficial adaptation of the heart in its task of pumping blood, the silent defect remains hidden like the enemy army within the Trojan horse The Maryland researchers found that the defect within each enlarged heart cell of the animal with high blood pressure — which they traced to the same cellular and molecular changes — is identical to the defect seen later in heart failures

Analogy with the Trojan horse aptly fits in because the defect appears to be masked initially by increased activity of the sympathetic nervous system which is able to improve heart function The defect, therefore, is not readily noticed according to Prof Lederer. However, as the sensitivity of the heart to continuous activity of the nervous system declines with time, the defect is unmasked and contributes to the developing heart failure.

Under normal conditions, the heart beats in response to a complex electrical-chemical process called excitation-contraction (EC) coupling During EC coupling, an electrical signal sweeps through the heart to trigger the contraction that pumps blood throughout the body. This wave of electrical activation spreads through the heart, permitting a minute amount of calcium to enter each heart cell through some 100,000 calcium channels that cover the surface of the cells These calcium channels are the targets for widely-used "calcium channel-blocker" medications

Normally, the calcium that enters through each calcium channel gives an extremely weak signal which must be amplified so that it can persuade the cell to act. Luckily, there are close to a million amplifier modules throughout the cell, conveniently locate close to the calcium channels They amplify the weak signal from the calcium channels to produce a much larger rise in calcium, which in turn causes the heart cells to contract

Investigations of Prof Lederer and his team on the EC coupling of heart cells of rats with high blood pressure displaying either simple cellular enlargement or contractile failure, have led them to the discovery of a surprising defect Although each of the elements in the calcium amplification system worked properly, the signals produced by the calcium channels were nonetheless inadequately amplified and thus remained muffled in both cells.

A New Hope for the Blind

British, surgeons have been able to restore a man's sight by inserting a piece of his tooth and jaw bone in his eye. The technique known as orsteo-odental keratoproshesis has been pioneered in

Italy by Giancarlo Falcinelli.

The sixty two year old patient who has lost his vision completely for nearly two years, can now read a newspaper The surgeons used a piece of patient's tooth and jaw bone to build a frame for ana artificial cornea.

In the first stage of operation an oral surgeon removed one of the patients' teeth and a piece of jawbone, then ground them into a miniature curved plate 9 mm long, 6 mm wide and 3 mm thick Later on the surgeon fixed a plastic optical lens into this plate to form ana artificial cornea and planted it to the eye

Galileo discovers Magnetosphere of Jupiter's moon

The US spacecraft Galileo began sending data about Jupiter's moon 'Ganymede' as it passed close to the moon in December, 1996. The audio recordings made from the data received from the planet sized largest moon of the solar system are characterized by a soaring whistle and hissing static "sound' which are attributed to its self-generated magnetic cocoon called magnetosphere The magnetosphere shields the moon from the magnetic influence of its giant parent body, the Jupiter

The scientists say that the new findings about Ganymede indicate that it has a closer resemblance with a planet like the Earth rather than other moons in the solar system According to the scientists, the approach of the spacecraft to Ganymede was relatively quite, "until all of a sudden, there was a big burst of noise that signalled its entry to the magnetosphere of the moon" The noise was typical of a passage through a magnetosphere and lasted for about 50 minutes Another burst was recorded at the time of the exit of the spacecraft from the magnetospheres.

Based on extremely precise data from the tracking spacecraft, investigators have been able to confirm that Ganymede's interior is differentiated, probably having a three layer structure. The data clearly shows that Ganymede has differentiated, into a core and mantle, which in turn is enclosed by an ice cell. The metallic core of the moon is about 400 to 960 km thick surrounded by a rocky silicate mantle which itself is enclosed by an ice shell of about 800 km.

It may be recalled that the spacecraft Galileo was launched in 1989 and it arrived at Jupiter on December 7, 1995. Since than it has been continuously sending back valuable data as it flies past Jupiter and its different moons

'Blood' may Increase Crop Yield in Future

If the findings of a recently reported research study are to be believed the plants may have a taste for 'blood' Leif Bulow and his colleagues at the University of Lund in Sweden have shown that the tobacco plants grow better when they are implanted with a gene that makes a bacterial version of haemoglobin, the red pigment in human blood responsible for the transportation oxygenated blood to different parts of the body Their experiments have revealed that by the end of three weeks, the tobacco plants carrying the gene had grown twice the size of their natural counterparts They also contained up to 40 % more chlorophyll pigment and a substantial rise in their metabolic rate The team now intends to test the effect of the gene in major crops like rice and maize However, some scientists though impressed by the unexpected findings of the study have speculated that some plant species might even suffer damage or have stunted growth if extra oxygen brought in by the haemoglobin triggers unwanted metabolic activity.

New Images Hint at Wet and Wild History for 'Europa'

Chunky ice rafts and relatively smooth, crater-free patches on the surface of Jupiter's frozen moon Europa suggest a younger, thinner icy surface than previously believed, according to new images from Galileo's closest flyby of Europa when the spacecraft came within 586 kilometres of the Jovian moon These features, which lend credence to the idea of hidden, subsurface of oceans, are also stirring up controversy among scientists who disagree about the age of Europa's surface

According to Dr Ronald Greeley, an Arizona State University geologist and Galileo imaging team member, the ice rafts reveal that Europa had, and may still, a very thin ice crust covering either liquid water wazzu or slush. These blocks ice which are similar to those seen on Earth's polar seas during springtime have puzzled the scientists. The size and geometry of these features suggest that there was a thin icy layer covering water or slushy ice, and that some motion caused these crustal plates to break up These rafts appear to float just like the icebergs on Earth Another puzzling observation is that these rafts appear to rotate as if being churned by convection

The new images of Europa's surface have also sparked a lively debate among scientists about have its age. Some of them believe that the smoother regions with few craters indicate Europa's surface is much younger than previously believed. This group estimates that the areas from where the data have been received may be a few million years old or less, which is about as young as any planetary surface besides Earth However, some others see things differently and put Europa's surface besides Earth. However, some others see things differently and put Europa's surface age at closer to one billion years old According to them the cratering rate at Jupiter is less than the cratering rate in the Earth-moon system. Therefore a smoother region should not be seen as an indicator of younger age

Scientists hope to find answers to some of the questions surrounding Europa and its possible oceans as the Galileo spacecraft continues its journey through the JOVIAN system. The craft will return for another Europa flyby on November 6, 1997, the final encounter of Galileo's primary mission.

Removal of Gall-bladder Stone Made Easier by the New Technique

A new, sound-driven, scalpel is helping surgeons remove gall-bladder stones from a growing number of school children they suspect are victims of "burger-cola-chip" diets.

Recently gall-bladder stones from a 7 year old boy were removed with this technology in a New Delhi hospital.

The technique brown as "harmonic scalpel" involves laparoscopic operation by making "button holes" in the body of the patient to insert surgical instruments and a camera lens for viewing. The biggest advantage of this technique is that the patient has to undergo a minimal trauma of operation and the post operation recovery is very fast. According to the doctors this technique could become standard for children suffering from gall-bladder stone since there is little physical or psychological damage to the patient as compared to traditional surgical operation.

The harmonic scalpel depends on sound energy to increase the cutting power of the blade and also to seal bleeding vessels by inducing tissue-protein to coagulate around surgical injury. So far, scalpels used for button-hole surgery have depended on electrical energy or lasers to achieve the same results. But unlike the harmonic scalpel both involve heat and often burn the tissues or damage nearby organs such as the liver

For the laparoscopic surgeon, who has to operate by watching the procedure on a video monitor, smoke from burning tissues can obscure the lens of the camera and hamper his work (UNI)

Gene to Help Lose Weight Discovered

Scientists have discovered a gene that might someday help people shed off excess fat at the cost of maintaining a slightly higher body temperature The gene appears to make people burn off calories, and it might help explain why some people are prone to getting fat. It is believed that researchers will soon be able to find a drug to make it work harder, so the body will burn off more calories rather than storing them as fat

It would raise body temperature continuously above the normal i e. 37° C. A person might be able to lose 2 kg a year with every one-tenth of a degree (about five one-hundredths of a degree C) Increase in body temperature according to the estimates made by the researcher Craig Warden of the University of California, Davis However, further studies are to be taken to find out how much of a temperature increase people could safely withstand

Scientists do not know as yet how people's bodies regulate their weight steering them toward a given weight despite dieting The cells of the body burn calories to get energy to do their jobs enabling our heart to beat, our legs to move, our thoughts to form and to generate heat for body temperature

It is believed that the new found gene is an energy thief. It gives rise to a protein that steals some of the energy the cells generate That means cells have to burn extra calories to make up for the low.

If scientists can prod the gene into making more of this energy-stealing protein, cells would have to burn still more calories

Researchers already knew of another gene that promotes energy theft, and drug companies are studying drugs to make it more active. But that gene called ucp 1, is active only in brown fat, which is sparse in adults

In contrast, the newfound gene ucp2 is capable of working in every human tissues especially ordinary white fat and muscle And its protein appears to be about 20 times more abundant in the body than the protein from ucp 1.

Ancient American s were Caucasoids

Skeletons unearthed in several western states and as far east as Minnesota in the USA are challenging the earliest Americans all resembled yesterday's Asians The skeletons' skulls bear features similar to those of Euro Caucasoid people were among the earliest humans to migrate into the New World more than 9,000 years ago.

Anthropologists have known of such bones for years, but did not fully appreciate their significance until reappear few months The new analyses were prompted by the discovery last summer of the newest addition to the body complete skeleton of an "apparently Caucasoid" man who died about 9,300 years ago near what is now Kenne

"It's an exciting time, and I think we're going to see some real changes in the story about the peopling of North Stanford, an authority on early human history on this continent at the Smithsonian Institution's National Muset think we're going to see the whole complexion of North American prehistory change real fast."

D Gentry Steele, an anthropologist at Texas A&M University, speculates that people of both races migrated into North America in separate waves, possibly thousands of years apart. Where they met, he suspects, they "made love, not war," and thus both populations may be ancestral to some or all of today's American Indians.

Until now, most anthropologists thought that the earliest humans to inhabit the Americas all resembled today's Asiatic peoples, popularly called Mongoloids Prehistoric Americans are thought to have migrated from Siberia into Alaska and then spread southward, probably during an ice age.

Earth is 13 Billion Old

According to measurements made from the Hubble space telescope orbiting the Earth, the universe is at least 13 billion years old. This figure has been given by two British scientist — Simon Goodwin and John Gribbin of Sussex University U.K.

The debate about the age of the universe have been continuing ever since the Big Bang theory for the origin of the universe was proposed The big bang theory postulated that the universe originated from a tiny point that exploded into the vast expanse of galaxies, stars and planets that exists today Measurements indicate that the explosion is still continuing, with the Earth and everything else still rushing away from this point. Physicists and astronomers believe that if they could measure the speed of this expansion, they could find out how long ago the big bang took place Estimates now range from 10 to 15 billion years

The paradox is that more accurate measurements do exist for the age of stars Some of the stars are at least 12 billion years old These measurements of astronomers are based on the data collected by them through instruments located on the surface of the earth. Many of them have been found to be inaccurate because of the problems posed by peering through the Earth's atmosphere.

The Hubble telescope has changed this scenario as it can gather data which is not hindered by the earth's atmosphere. According to Dr. Gribbin, the Hubble data collected during 1996 have made it actually possible. His team had used a simple technique. How big a galaxy looks depends on how big it really is and how far away it is Very accurate measurements of actual distance have been made using stars known as Cepheids, which brighten and fade in a regular rhythm.

Gribbin's group had calculated the average size of more than 3,000 galaxies and determined that the Milky Way galaxy, of which the Earth is a part, is pretty close to average. In fact, the number of galaxy having close to the average size has amazed scientists How fast the galaxies are moving is easy to measure using the distortion of light, known as a red shift, coming from distant stars. The shift in the wavelength of light from a distant star depends on the speed it is moving away from the observer. This is known as the Hubble's law and is similar to the Doppler effect on sound which causes the sound of a moving train to rise and fall as it passes

Using all these measurements, the team of scientists have calculated the Hubble constant-- the key to the rate of expansion of the universe and thus of its age. The measurements have shown that the Hubble constant to be about 50 That would make the universe at the very least 13 billion years old

Thirteen billion is really the lowest age estimated by the team led by Dr Gribbin Noting that the latest estimate of the oldest stars was 12 billion years old, it gives just enough time for the evolution of the other celestial objects that are present in the universe

Book Review

Careers in Science

By-Dilip M Salvi, published by UBS Publishers' Distributors Ltd , New Delhi, 1996 pp 116, Rs 75

In this context, the book 'Careers in science' by Dilip M Salvi will be heartily welcomed not only by the children who are at the threshold of making a crucial decision which would set the direction of their future course of action, but also by their parents who are equally worried about their childrens' future prospects In the present scenario when a scientist Hale codiscoverer of Hale-Bopp comet fame had declared in sheer despondency that science was unable to provide him a job, naturally every one remains sceptical about his or her decision for opting a career in Science

However, this book in its lucid and comprehensive style tends to dispel this myth that science does not bring prestige Power or money Rather, it unfolds variegated field of job opportunities which one can choose according to one's taste, inherent nature and capabilities

The book is not a mere collection of careers in Science but provides adequate guidelines and tips for the readers to carefully examine all aspects of each career, his own interests and mental make-up and steps to arrive at a decision. The writer begins with a discussion in detail on the distinct categories in which careers offered by science can be divided In a very pragmatic approach the writer has described that how the knowledge of science when blended with almost any venture can make it a real success.

But at the same time the writer minces no words in telling the fact that opting for science means hardwork and to a large extent abstinence from the leisures of college life yet it's a good bargain, for the hardwork done during the few years of student life gives a good harvest throughout the life.

After giving a glimpse of all the possibilities that science provides, the author then stresses on knowing one's own nature This is the foremost thing that one should do so that the opted career would sustain on's interest through out life This alone will be able to provide job satisfaction apart from other inherent advantages of that particular career In the second chapter on careers that science offers the writer has dealt in detail with the possible careers best suited for different individuals - from loners to gregarious ones

Once the choice for taking science has been made, the writer cautions everyone to be pragmatic in choosing a definite career that science offers For, the scene in the job market is fast changing and everyone must ensure his or her future prospects of the career opted For this, one has to keep oneself abreast with the national policies and trends.

In the section on 'Something else required too,' the writer brings the prospective career-section face to face with ground level realities. Although, here he has tried to give a few illustrations which seem to be too simplistic, yet these would set the thinking process in correct prospective in the minds of all those who would always think twice before going for a career

In the end the writer has listed in Appendix I , Some frontiers in science and technology which are fast opening not only in India but in other countries too. Like a ready reckoner, this could be of great help for all those who do not have access to other sources of in*formation*.

He has even given a list of popular magazines in Appendix-2 which cover various aspects in science and technology so that one could acquaint oneself with the latest in various fields In the end, a list on various professional bodies in India has been given so that anyone, if intended, could become its member and widen his interests The writer has given a list of further readings, with a brief outline of each, so that one can choose books of ones interest. In fact the variety of information contained in appendices will not only be of immense help for individuals but even for institutions offering these courses in science subjects

The exhaustive manner in which the writer has dealt with the subject makes this book a must in all school libraries so that the young students in the absence of any proper guidance *regarding career, as is the case with* most of the schools, may at least consult this book

ABHA JOSHI
Principal
Sarvodaya Girls School
Lancer's Road,
Delhi 110 054

Numerical Problems in Chemistry

By N.N Sarin and R.N Sarin, Published by Sultan Chand & Sons, New Delhi, 1997 (twenty-third edition), pp 962, Rs 120

The assessment of pupil's performance is an integral part of any teaching and learning process Examinations and *tests should be made use of to bring* about a qualitative improvement in education, specially science education The method of assessment of pupil's performance should be a reliable and valid tool to measure the former's development and a powerful instrument to bring about an improvement in the quality of teaching and learning In functional terms, this would mean that the method of assessment of pupil's performance should be such as

(i) to eliminate the excessive element of chance and subjectivity ,
(ii) to discourage memorisation of subject matter ;
(ii) to subject the pupil to continuous and comprehensive evaluation incorporating- both scholastic and non-scholastic aspects of education ; and
(iv) to ensure effective use of the evaluation process by teachers and pupils.

These are some of the goals relevant both for external examinations and evaluation within educational institutions.

One of the major weaknesses of the existing pattern of examinations is that they have almost become the main goal of education rather than being a means for validating the educational process. The evaluation is mostly used for certification, grading of students and for promotional purposes It is important to know the relationship that evaluation has with instructional objectives, content of education and instructional strategies

The idea of objective - centred testing can be put into practice in the development of teaching - learning units which form the present instructional-cum-evaluation material The material *presented in this book may be taken* as a sample material for the guidance of teachers and tutors of chemistry who, in turn, can develop similar material keeping in view their needs and resources The users of this material are advised that the various types of activities and questions included in this book are only suggestive and not exhaustive Many more questions can be devised. It is only through actual tryout by the teachers in the class that they would be able to know the relevance and usability of the present textbook containing numerical problems in chemistry in the actual classroom situation.

In the present book on "Numerical Problems in Chemistry", the coverage of the subject matter is very vast Apart from the topics which are usually included in the subject of chemistry at the senior secondary level, numerical problems on topics such as measurement, significant figures and uncertainty in measurements, percentage composition, empirical and molecular formulae of inorganic compounds, laws of chemical combination,, vapour density and molecular weights of volatile substances and gases, equivalent weights, volumetric analysis, audiometry and estimation of elements and determination of molecular weights and empirical and molecular formulae of organic compound have been included The inclusion of these topics will help greatly in developing the manipulative skills of the students Topics of special use to those students who are preparing for premedical, pre-dental examinations conducted by various medical colleges and joint entrance examinations for admission to engineering courses conducted by the IITs and other institutions are the problems on vapour density and molecular weights of volatile substances, gas laws and kinetic theory of gases, atomic structure and nuclear reactions, chemical equations, gas analysis and estimation of elements and determination of molecular weights. Some of the problems included in these topics are indeed brain raking and make the students use their application skill to solve them

Polymers and colloids are such substances which are used in our daily life in one or the other form Therefore, complete omission of problems on polymers and colloids, including the phenomenon of adsorption, which form a part of the syllabus in chemistry for the senior secondary stage, is not desirable

In spite of utmost care by the authors, some mistakes, errors and omissions have crept into the book These discrepancies are mostly due to avoidable editorial inadequacies. Some of the significant errors are as follows

(i) Stops (.) have been put after the units e.g. g., ml., mm. Moreover, there is no uniformity in writing the units e.g mols, moles and M or volts., Volts and V have been used at different places.

(ii) Units have been expressed in plural at several places e g grams instead of g, mols , volts , atms

(iii) Abbreviations have been erroneously used at many places e.g vols. for volumes, anhyd for anahydrous, sod. for sodium, Q for quaternary, Am. for ammonium and alc for alcohol

(iv) use of erroneous notations such as Zn (for zn), MnO_4, No_3^{-1}, SO^{-2}_4, Cr^{+3}, Mn^{++} etc at different places

(v) Some words have been misspelled e.g. Hoffmann as Hoffman (in fact, both the spellings have been used), aqueous as aqueous as acqueous, beryllium as berylium, zinc as zine

The quality of printing is very poor at many places as the print is almost illegible. Moreover, there is a considerable variance in the type-size throughout the book At some places, the type-size is broken and so small that the words are not discernible.

On the whole, the book is very useful for the students intending to appear for the +2 examination in chemistry conducted by various boards of secondary education, and also for those students who are preparing for pre-medical and pre-engineering entrance tests, as it includes both solved and unsolved questions from IIT-JEE, Roorkee entrance, CBSE and Maharashtra SS Board and problems from other sources

K. M Pant
Reader in Chemistry
DESM, NCERT
New Delhi.

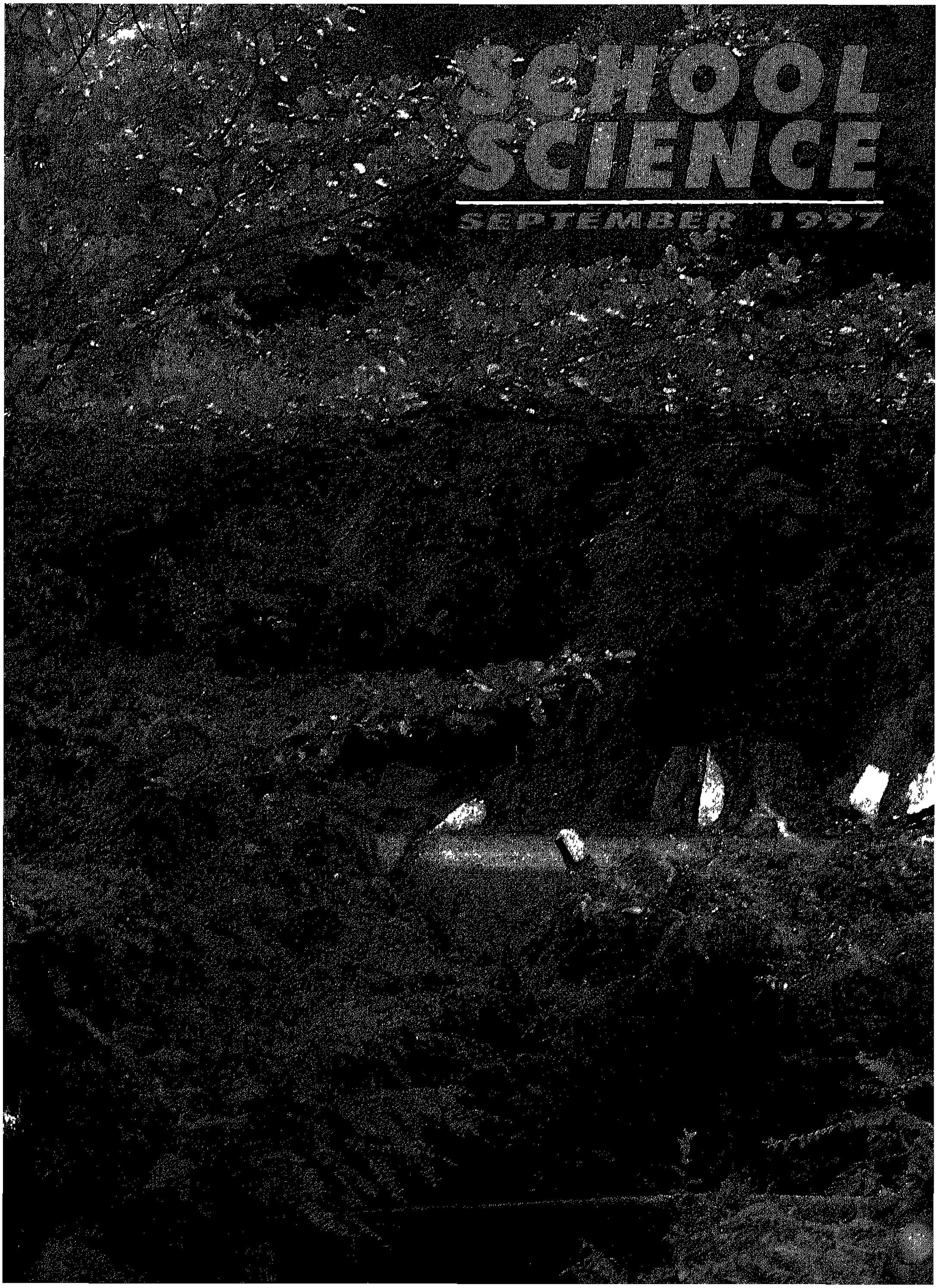
SCIENCE RELATED VALUES

Curiosity, quest for knowledge, objectivity, honesty and truthfulness, courage to question, systematic reasoning, acceptance after proof/verification, open-mindedness, search for perfection and team spirit are some of the basic values related to science. The processes of science, which help in searching the truth about nature and its phenomena are characterised by these values. Science aims at explaining things and events. Therefore to learn and practise science :

- **Be inquisitive about things and events around you.**
- **Have the courage to question beliefs and practices.**
- **Ask 'what', 'how' and 'why' and find your answers by critically observing, experimenting, consulting, discussing and reasoning.**
- **Record honestly your observations and experimental results in your laboratory or outside it.**
- **Repeat experiments carefully and systematically if required, but do not manipulate your results under any circumstance.**
- **Be guided by facts, reasons and logic. Do not be biased in one way or the other.**
- **Aspire to make new discoveries and inventions by sustained and dedicated work.**

SCHOOL SCIENCE

SEPTEMBER 1997



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Articles suitable to the objectives mentioned above are invited for publication. An article sent for publication should normally not exceed ten typed pages, and it should be exclusive to this journal Illustrations should be drawn with pen and indelible ink. Photographs (black and white), at least of postcard size, should be on glossy paper and should be properly packed to avoid damage in transit

Manuscripts with illustrations, charts, graphs, etc along with legends, neatly typed in double space on uniform sized paper, should be sent to the Executive Editor, SCHOOL SCIENCE, Department of Education in Science and Mathematics, NCERT, Sri Aurobindo Marg, New Delhi 110 016.

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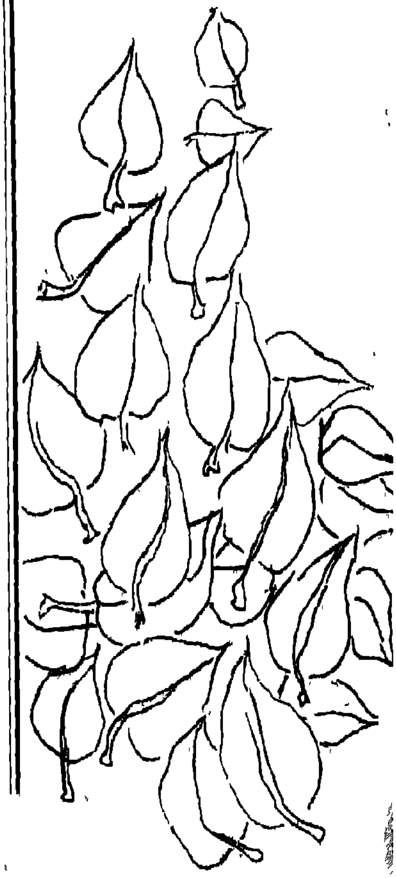

TO OUR CONTRIBUTORS

SCHOOL SCIENCE *invites articles from teachers, acquainting students with recent developments in science and science methodology. The articles should be addressed to the Executive Editor, Department of Education in Science and Mathematics, NCERT, Sri Aurobindo Marg, New Delhi 110 016*

Environmental Pollution Due to Cadmium, Mercury, Lead, Arsenic

PROF M. CHANDRA
Department of Education in Science and Mathematics
National Council of Educational Research and Training
New Delhi 110 016

Recovery of metals has been an ancient trade and the toxic effects of the metals, particularly lead and mercury were not unknown to our ancestors But a phenomenal increase in industrialisation, urbanisation, increase in vehicular traffic and the use of fertilizers and pesticides in agriculture have resulted in increased contamination of our environment by metals. The impact of metal pollution on human health and its global significance have thus become a major issue of public concern in the last few decades. One of the glaring instances of poisoning, due to metal-mercury in this case, has been the "Mianmata Disaster" in Japan, where thousands of people in Mianmata, a fishing village in Japan, were affected in the '50s, due to mercury poisoning from a chemical plant which discharged its mercury containing residue into the Mianmata Bay. A similar tragic instance that faces India today, is the poisoning of water due to arsenic (a metalloid) in certain districts of West Bengal.

To give an idea of this problem, we shall discuss here, in some detail, the issue of environmental pollution due to four of the most polluting elements—cadmium, lead mercury and arsenic In the previous issue of the Journal we have given an overview of the pollution due to these four elements, and in the forthcoming issue, we shall discuss briefly, the efforts being taken to remove these from the environment

Cadmium

Cadmium is regarded as one of the highly toxic elements in the environment. The natural sources of cadmium are volcanic activity, ocean spray and forest fire However, emission of cadmium to the atmosphere from anthropogenic sources exceeds those from natural sources Non ferrous metal mines, smelters and refineries, coal combustion, refuse incineration, iron and steel industry and phosphate fertilisers are the main sources of cadmium to the environment due to human activities. Cigarette smoking contributes significantly to cadmium intake and tobacco containing cadmium is present as a finely dispersed aerosol* in cigarette smoke Chemically, cadmium being very similar to zinc, these two metals frequently undergo geochemical processes together Also since cadmium in native state occurs in association with zinc minerals, growing plants which require zinc, take up cadmium along with zinc. Food is, therefore, the main route by which cadmium enters the human body Sea food and organ meat generally have high levels of cadmium, but majority of cadmium in the diet usually comes from potatoes, wheat, rice and other grains. Since cadmium uptake by plants increases with decrease in pH, therefore, acidic soils help increase cadmium level in food.

Although Cd^{2+} is rather soluble in water, human beings usually receive only a small proportion of cadmium from drinking water (or directly from air) Exception occurs, however, for individuals who live near mines and smelters, particularly the ones that process zinc Tobacco smoking and occupational exposure (specially mining and electroplating) increase the risk of cadmium intake by human beings (1). Smokers are also exposed to cadmium that is absorbed by tobacco leaves from irrigation water (2)

In India, the maximum detected level of cadmium in air has been reported in West Bengal; in water in Kerala and Andhra Pradesh, and in food in Punjab and Haryana It has been observed that more than 50% of the soil samples from Punjab and Haryana are sandy with low in organic matter, low in pH and deficient in zinc, conditions favourable to promote cadmium uptake by plants. Sea water from Bhavnagar in Gujarat, used for preparation of salt is also found to contain cadmium more than the recommended permissible limit (3).

Toxic Effects of Cadmium

The effect of acute cadmium poisoning in humans are very serious. It is a cumulative poison, since it is not eliminated quickly — its life time in the body being several decades (4) Toxic effects mainly include high blood pressure, kidney damage and destruction of red blood cells It is believed that much of the physiological action of cadmium arises from its chemical similarity to zinc. Thus, cadmium may replace zinc in some enzymes and thereby may alter the stereostructure of the enzyme and impair its catalytic activity (5)

Historically, all serious episodes of cadmium contamination have resulted from pollution from the nonferrous mining and smelting industries. The most alarming of these being the one that occurred in the Jintsu river valley in Japan where people contracted a bone disease called "itai itai" (in Japanese) In this disease, some of the Ca^{2+} in the bone apparently gets replaced by Cd^{2+}, since both Ca^{2+} and Cd^{2+} share same charge and virtually same size*. The bones gradually become porous, leading to fracture and collapse (6).

---

* aerosols are colloidal systems in which liquid, or sometimes solid particles with a diameter measuring about 10^{-2}mm to 10^{-6} mm are distributed in a gas phase (such as air) Such two-phase distributions can be artificially produced by aerosol products.

Mercury

Mercury has long been part of our environment, it existed long before any industrial development, and over the millennia living beings have developed tolerance to the small doses of natural mercury Mercury is present in earth's crust, but the major sources of natural mercury are the natural "degassing" (evaporation) of the earth's crust through volcanic gases and the evaporation from oceans. Mercury exists in the environment as the metal, as inorganic salts and as organic methyl mercury Mercury is found as a trace component in many minerals, fossil fuels coal and lignite — a matter of some concern — because of increased use of these fuels as energy sources. Mercury is leached from soils (some of this mercury being accumulated by human activities as well), into water systems by natural processes Depending on the species, plants also accumulate mercury through three routes: from the soil through their roots, from the atmosphere through the stomata and by retention of particulate mercury (7). Though India does not have an indigenous production of mercury, but because of the toxicity and polluting nature of mercury, India shares with the rest of the world, great concern for mercury as a heavy metal pollutant (8).

In recent years, it has been established that flooding of vegetated areas can release mercury into water. Dimethyl mercury, $Hg(CH_3)_2$ results from contact of soil bound Hg^{2+} with anaerobic bacteria produced by the decomposition of immersed organic matter. In this way, previously insoluble inorganic mercury gets converted to a volatile dimethyl mercury. The less volatile CH_3HgX (X=Cl, OH), often collectively known as "methyl mercury" are formed in a similar way, only more readily than dimethyl mercury An acidic medium promotes the conversion of dimethyl mercury to methyl mercury This is a more potent toxin than dimethyl mercury or elemental mercury, because it is soluble in fatty tissues in animals and therefore, bioaccumulates* and biomagnifies* there Most of the mercury present in the human body is in the form of methyl mercury and most of it originates from fish in our food supply The half life period of methyl mercury in human beings is about seventy days Consequently methyl mercury can accumulate in the body, even if, on a daily basis, a person consumes doses which individually would not be harmful. Many of the well published environmental problems involving mercury have arisen in connection with the fact that in the methylated form, it is a cumulative poison (9)

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* Ionic radius of calcium is 100 pm and that of Cd^{2+} is 95 pm

* The toxin can be taken up by living organisms so that progressively through predators, it magnifies to levels greater than the levels found in the environment.

Plants and soils have also been found to discharge gaseous elemental mercury at rates significant enough to affect the amount of this pollutant in air. Plant physiologists have shown that plants take up mercury and release it through transpiration, in a manner similar to the way methane moves from soil through rice plants (10) The phenomenon has been observed with aquatic plants growing in mercury contaminated sediments, but it was never suspected in terrestrial plants growing in basically clear soils. It has been observed that even soils that have not been directly affected by an industrial spill, and agricultural soils are also strong emitters of mercury vapours. The notion that mercury is re-emitted to the air from the earth's surface is not new, since the volatility of mercury is a well established fact. However, these findings suggest that natural processes may have a stronger effect on the amount of mercury that gets into the atmosphere than previously thought and not all the mercury that gets into the atmosphere is necessarily coming from human activities. It is found that a form of water soluble divalent gaseous mercury compound (a gas also identified in stack gases and from industrial sources) make upto 1 to 5% of the mercury in ambient air

The discovery of natural emission of mercury from soils and plants suggests that managing mercury emission to the environment may differ from other pollution, since unlike the other pollutants, reduction of mercury emission due to anthropogenic reasons may not be the solution for removing this polluting agent from the environment Measured gas phase emission of mercury has been estimated to 100 nanogram/square metre/hour over a forest canopy and upto 75 nanogram/square metre/hour over soils These amounts are low in comparison with those from industrial sources, but the difference is that, for every coal fired power plant, there may be thousands of square kilometres of forested areas (11)

The anthropogenic sources of atmospheric mercury have increased substantially in the 20th century and now match with the input from volcanoes — formerly the predominant source of airborne mercury However, the principal use of mercury has undergone great changes in recent decades At the turn of the century, the main uses of the metal were in the recovery of gold and silver — uses which have essentially disappeared. Applications in agriculture, pharmaceuticals and general laboratory practices have also declined in the last twenty years, whereas applications in electrical apparatus, chloroalkali plants and dental filling have increased. Taken individually, each of these may not contribute much to the toxic metal in the environment, but their total effect can be substantial. The most significant anthropogenic activity of all, that gives rise to emission of mercury to the environment is, burning of fossil fuels and industrial processes (12).

In India since most of the thermal power plants use pulverised coal, this may cause a major threat to the environment as far as mercury pollution is concerned Not only is the mercury content of coal in India higher than that of coal used elsewhere in the world, but the coal used being of lower grade, the consumption of coal per unit of power production in India is also high It is thus predicted that mercury emission for each unit of power generated in India is also high Because vapour pressure of mercury is very high, and due to the high combustion temperature, even with the most effectively controlled fly ash control systems, a major fraction of mercury is still emitted to the atmosphere, which condenses on dust particles. To study this and related phenomena, the National Environmental Engineering Research Institute (NEERI at Nagpur), had recently conducted an ecological survey of the distribution of mercury in air, soil and vegetation, around the Kobra thermal power station in central India. One of the observations of this survey was that a slightly higher level of mercury is observed in winter on soil, may be due to increased fuel combustion, and poor dispersion of pollutants in the winter evenings. In summer, mercury levels are slightly lower, because mercury evaporates more into the atmosphere due to higher temperatures The survey observed that the level of mercury in air is minimum in post monsoon periods may be due to a washout of pollutants from the system The survey also found that as one goes down below the surface, the subsoil mercury levels decrease in comparison to the top soil mercury (13).

Toxicity of Mercury

Elemental mercury is fairly inert and not toxic and if swallowed, it is excreted without serious damage. However, since mercury has a high vapour pressure, it is volatile and if inhaled enters the brain through the blood stream. This can lead to severe damage of the central nervous system. Hence, mercury should be handled only in well ventilated areas and if spilt, should be cleaned up as quickly as possible Hg_2^{2+} (mercurous ion) forms an insoluble chloride with Cl^- and since our stomach contains fairly high concentration of Cl^-, Hg_2^{2+} is not toxic Hg^{2+} (mercuric ion), however, is fairly toxic because of its high affinity to sulphur atoms It easily attachs itself to sulphur containing amino acids of proteins Hg^{2+} also forms bonds with haemoglobin and serum albumin, both of which contain sulphydryl groups Hg^{2+} does not, however, travel across biological membranes and so it has no access to biological cells (14). The most toxic species are the organomercuric compounds particularly methyl mercury CH_3Hg^+ because it is soluble in fatty tissues in animals,and therefore, and it bioaccumulates and biomagnifies there. Once ingested CH_3HgX interacts with the sulphur containing amino acids In some of these forms it is soluble in biological tissues and can cross both the blood brain barrier and the human placental barrier, presenting a two-fold hazard (15) The covalent Hg–C bond in these compounds is not easily disrupted and the alkyl mercury is retained in cells for prolonged periods of time. The attachment of mercury to cell membranes may inhibit active transport of sugar across the membrane while allowing the passage of potassium across the membrane. In case of brain cells, this results in energy deficiency in the cell and disorders in the transmission of nerve impulses Thus, babies born of mothers exposed to methyl mercury poisoning suffer an irreversible damage to the central nervous system (16). In addition to the direct toxicity of alkylmercury compounds, their slow decomposition to inorganic Hg (II) ion may lead to secondary toxic effects as well

Lead

Lead is considered to be one of the severe environmental contaminants to arise in human civilization Lead is a natural constituent of the earth's crust and occurs naturally in plants In the environment lead exists almost entirely in the inorganic form. Lead bearing limestone and galena (Pbs) contribute lead to natural water in some locations The zawar deposit in Rajasthan is the only source of lead in India (17)

Lead is a trace element and is present less than 0 1% by weight in rocks and soils. But soil is a sink for anthropogenic lead and this has helped in lead accumulation in the environment as a result of widespread use of lead by humans. Mining, smelting activities, sewage sludge usage in agriculture, and above all gases discharged by automobile exhausts are some of the well recognised sources of anthropogenic lead in the environment Lead is "particle active" which results in effective scavenging of lead by particles in many lead emissions and environmental cyclic processes. This accounts for the effective transport of lead in particulate phases and its accumulation in many environmental materials e g. terrestrial urban soils, estuaries and near shore sediments (18). However, there is a general agreement that only a small proportion of lead in soil is available for uptake by plants, although there is little evidence that lead is readily lost from soil profiles by leaching. Lead has a long life time in the atmosphere compared with most pollutants Lead and its compounds accumulated in soils and sediments are found to be of low solubility They also have relative freedom from microbial degradation and remain accessible to the food chain and to human metabolism for a long time in future The life time of lead in soil is so long that it can be regarded as permanent component in soils Fortunately, alongwith low solubility and mobility, the bioavailability of lead is also low (19)

Food is the major source of lead intake for most people. Most lead enters articles of food during storage and processing e.g. canning, brewing etc. Acidic media and high temperature facilitates leaching of lead from glazed pottery sold in North India (Though not a food item, but "surma" used predominantly in India also has a high lead content).

A major source of lead in the environment is petrol, as tetraethyl lead is added to petrol to prevent spontaneous premature combustion of the fuel mixture and knocking. The effectiveness of tetraethyl lead as an antiknocking agent relies on its ability to get easily oxidised to lead oxide. The lead oxide so produced enters the human body through inhalation and skin contact. Tetraethyl lead is also readily absorbed through the skin, the amount so absorbed increases with area of skin involved However, the possibility of human contact with leaded petrol other than through occupational exposure is slight. The link between lead and petrol, and lead in humans is well established. Children living near busy streets have been measured to have lead levels in their blood around 300 microgram/litre, while those living in rural areas with low traffic density have lead of around 150 microgram/litre, or even less. Studies have also shown links between amounts of lead present in breast milk and the density of traffic at the place where the mothers live (20). Lead from automobile exhausts and from industries accumulate in the form of dust; while a significant proportion of fuel lost by evaporation from the fuel tank and carburetter of vehicles add lead to the atmosphere as well. In addition, there is considerable loss of unburnt fuel from two-stroke engines of mopeds, motorcycles and scooters.

Lead is utilised in lead acid batteries and in yellow lead chromate used in road markings. Air bound lead oxide from many of the above sources eventually settles in soil, water, fruits or leafy vegetables and thereby enters the food chain. Microorganisms do bioaccumulate lead, but in contrast to mercury, lead does not undergo biomagnification in the food chain. Also, in contrast to mercury, lead does not generally become an environmental problem, until it is in the ionic form.

On an average, roads in Indian cities have been found to contain 2 gram of lead/kilogram of dust, with levels being alarmingly high in Calcutta, Delhi and Mumbai (Table 1). According to estimates prepared by the National Environmental Engineering Research Institute (NEERI, Nagpur) the amount of lead in air by 2000 A.D. is expected to be 103, 91 and 50 metric tonnes in Delhi, Mumbai and Calcutta respectively (21). Am analysis of lead content in water bodies and in food items have shown that, West Bengal leads in lead content in water, while food samples tested from West Bengal, Orissa and Himachal Pradesh have tested to contain traces of lead (22). To help reduce air pollution due to lead, the Government of India has decided that cars that are being produced/marketed to the four metropolitan cities of Calcutta, Mumbai, Delhi and Chennai, will henceforth not be allowed to have engines that use ordinary leaded petrol. The new cars for these cities are being fitted with special catalytic convertors which also converts other pollutants emanating from vehicular exhaust pipes, viz carbon monoxide, hydrocarbons and oxides of nitrogen to (non polluting) carbon dioxide, water and nitrogen (23). Since 1st April 1995, unleaded petrol (meant for the new cars) is being sold in these four cities and also in some other selected cities of India.

TABLE 1

Level of lead in Calcutta, Delhi and Mumbai

City	*ppm*	
Calcutta	1.0 16	WHO standard is 0.5 ppm
Delhi	0.2 14	
Mumbai	0.2 18	

Source. Chemical Industry News April (1995) 530.

Lead has been a constituent of soldering material and some pipe formulations, so that household water may have some contact with lead. Although lead is partially removed from most conventional water treatment process and hence concentration of lead in treated water is low, but because of lead used in plumbing, water that has remained in household plumbing for sometime, may accumulate perceptible levels of lead (alongwith zinc, cadmium, copper). Thus tap water should be allowed to run for a while before being used However, due to a general decrease in the use of lead in plumbing, except in isolated cases, lead probably is no longer a major problem in drinking water.

Toxicity of Lead

Most ingested lead in humans is initially present in the blood, but this amount eventually reaches a plateau and the excess amount then enters the soft tissues including vital organs, particularly the brain Eventually the lead becomes deposited in bones, where it replaces calcium, because Pb^{2+} and Ca^{2+} are similar in size* Lead adsorption by the body increases in persons who have calcium deficiency and is higher in children than in adults. Lead remains in human bodies for several years The dissolving of bones as occurs in old age or illness, results in remobilising of bone-stored lead, back into the blood stream where it can produce toxic effects

Biochemically, lead interferes with the creation of haemoglobin by interfering with the enzymes involved in the process At high levels, anaemia can occur due to lack of this oxygen carrying component in the blood High lead level also produces kidney impairment and causes permanent brain damage The human group most at risk (from high levels of Pb^{2+}) are children under seven years and fetuses, since lead readily crosses the placenta and is passed from mother to the unborn child

On an atom to atom basis, though lead is not as dangerous as mercury, however, the general population is exposed to lead from a greater variety of sources, and generally at levels higher than those associated with mercury Overall, more people are adversely affected by lead, though on the average, to a lesser extent, than those fewer individuals exposed to mercury (24)

Arsenic

Arsenic occurs naturally as a sulphide associated with sulphides of silver lead, copper, nickel, antimony, chromium and iron, Five per cent of the arsenic present in the atmosphere is in particulate form and originates due to the low temperature volatilisation of arsenic from soils by micro organisms Volcanoes are the next most important natural source of arsenic Although arsenic and its compounds are well known for their toxic properties, but fortunately the species that are most commonly found in soils are not the most toxic However, arsenic is considered as one of the worst water pollutants. The uptake of arsenic by many terrestrial plants is not very high, even on soils which have a relatively high arsenic concentration Therefore, plants do not usually contain dangerous levels of arsenic and only small background levels of arsenic is found in certain food items. Soils have been generally less badly affected by arsenic build up than aquatic sediments, and this lack of long term building up of arsenic in soils has been explained as due to the formation of volatile arsenic compounds by microorganisms and by leaching (25)

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* ionic radius of lead is 119 pm and that of calcium 100 pm

Drinking water, especially ground water is a major source of arsenic for most people, as has been found in West Bengal. Malda, Murshidabad, Burdhaman, Nadia, Hughli, 24 Parganas have been considered as the most affected region of the world, as far as arsenic contamination is concerned, the districts of Howrah and Medinipur may also be affected. In these six districts, covering an area of 34,000 square kilometres with a population of 30 million, arsenic in ground water has been found to exceed the WHO limit of 0.005 milligram/litre. The conventional wisdom is that the source of arsenic is geological, experts however differ with this view as well (26). According to one school of thought, maximum withdrawl of ground water is causing arsenic contamination According to this theory, poisoning started thirty years ago, when wells were sunk in rocks in the flood plains of the river Ganga, to irrigate new strains of rice during the dry season They were unaware of the fact that the underground strata contained arsenic Historically, the villages used surface water But the new tube wells, which tap water from 150 metres or more below ground, provided abundant water to irrigate high yielding varieties of rice, that have revolutionised rice crops each year Unfortunately, this economic gain has come at a tragic human cost. Studies related to these affected villages have found seams of iron pyrites containing arsenic, which may be contaminating the wells. Poisoning probably onsets as soon as pumping starts, growing worse as over pumping lowers the water table in the rocks As the water level falls, the arsenic bearing sulphide rocks dry out. Oxygen penetrates the rocks, oxidising the sulphide mineral. This in turn sets free the arsenic to be dissolved in the ground water. Wells which go below about 200 metres are usually arsenic free, at least until the water table falls further and oxygen reaches lower depths (27) Scientists of the Tropical School of Medicine, Calcutta, were the first to identify this widespread poisoning Studies which are continuing, however, show that there may be other reasons as well A study by the scientists of the Jadavpur University in Calcutta, on 20,000 tubewells of 560 villages of these 6 districts has shown that more than half of these tubewells showed water samples which contain 0.05 milligram/litre of arsenic, and in certain cases, the concentration is about 20 to 30 times more than what is regarded safe (28).

As far as anthropogenic source of arsenic is concerned, smelting of copper is the largest single input, representing about 40% of the anthropogenic total Coal combustion is the next most significant source, which accounts for about 20% of the total anthropogenic arsenic. Much of the arsenic introduced into the atmosphere in this way ultimately reaches natural water Arsenic produced as a by-product of copper, silver, lead refining greatly exceeds the commercial demand of arsenic and this accumulates as waste material (29). Due to similarity in properties, arsenic compounds coexist with those of phosphorous in nature, thus contaminating phosphate deposits and commercial phosphates (30).

Toxicity of Arsenic

The toxicity of arsenic depends on its chemical and physical form, the route by which it enters the body, the dose and the duration of exposures (31). In fact, arsenic in minute quantities may even be an essential nutrient for living beings. Also arsenic by itself is rarely directly lethal, except when deliberately administered or ingested in amounts greater than 100 milligrams. However, arsenic poisoning is cumulative, with tiny amounts of arsenic building up in the bodies of the victims for many years, until physical symptoms emerge. Also, chronic poisoning leading eventually to deaths may also be frequent (32) The toxic activity of arsenic depends on its molecular form with mechanism of toxicity differing with the valence state of arsenic. Most organic arsenic compounds are substantially less toxic than the inorganic form — As (III) being more toxic than As (V). This is because, As (III) can be retained in the body for longer time, because of its ability to be bound to sulphydryl (-SH) groups of enzymes, thereby inhibiting enzyme action (33). As (III) compounds in high concentration form complexes with enzymes, they also coagulate proteins, possibly by attacking the sulphur bonds The toxic mechanism of As (V) is less well understood than that of As (III). By virtue of its chemical similarity to phosphorous, arsenic interferes with some biochemical processes involving phosphorous (34).

In the initial stages, arsenic poisoning leads to chronic conjunctivitis, bronchitis and gastro enteretitis. It eventually results in acute liver damage and gangrene. Arsenic is also known to be carcenogenic to humans, leading to lung cancer, skin and liver cancer. There is evidence that smoking and simultaneous exposure to environmental arsenic act synergestically* in causing lung cancer. Its lethal effect when consumed in an acute dose is due to gastrointestinal damages resulting in severe vomiting and diarrhoea (35)

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* i.e. their effects taken together is greater than what the sum of their individual effects would be, if each acted independently.

REFERENCES

1. Krishnamurthy (C R.) and Viswanath (P). Health Impact of Environmental Exposure to Heavy Metals: An Overview.
2. Baird (C S.) *Environmental Chemistry* W.H Freeman & Co (1995) 484 pp.
3. Chandra (S V.) Toxic Metals in Environment (1980) 65 pp.
4. Same as in 2 above
5. Manahan (S.E.) *Environmental Chemistry*. Lewis Publishers (1994) 811 pp.

6 Same as in 2 above

7. Sengar (C.B S.), Soni (D K) and Aggarwal (A.L.). Distribution of Mercury in Air, Soil and Vegetation around a Coal Fired Thermal-Power Plant. *Energy Environment Monitor* 2 (1989) 61-67.

8. Same as in 1 above.

9 Same as in 2 above.

10. Chandra (M). Greenhouse Effect and Global Warming. Mimeo (NCERT) 64 pp

11. Rouhi (M). Studies Show Plants, Soils Emit Mercury, *Chemical and Engineering News* Feb (1996) 36-37.

12. Alloway (B.J) (ed.) Heavy Metals in Soils John Wiley and Sons Inc (1990) 338 pp.

13. Same as in 1 above.

14. De (A.K) *Environmental Chemistry*. Wiley Eastern (1987) 265 pp

15 Same as in 2 above.

16 Same as in 14 above.

17 Same as in 1 above.

18. Smith (D.R.) and Flegel (A.R) Lead in the Biosphere : Recent Trends. Ambio 24 (1995) 21-27

19. Same as in 12 above

20 Motluk (A) Lead Blight the Future of Africa. *New Scientist*. March (1996) 6

21 *Chem & Ind News* April (1995) 530.

22 Same as in 1 above.

23 Chandra (M) Acid Rain Mimeo. (NCERT) 61 pp.

24. Same as 2 above

25 Same as in 12 above

26 Arsenic Pollution in Deep Water. *Chemical and Industrial News*. April (1995) 533

27. Pearce (F) Death and Devils' Water *New Scientist*, Sept., (1995) 415

28 *Chemical and Industrial News* June (1996) 819-821

29 Same as in 12 above

30. Same as in 2 above.

31 Same as in 1 above.

32 Same as in 27 above

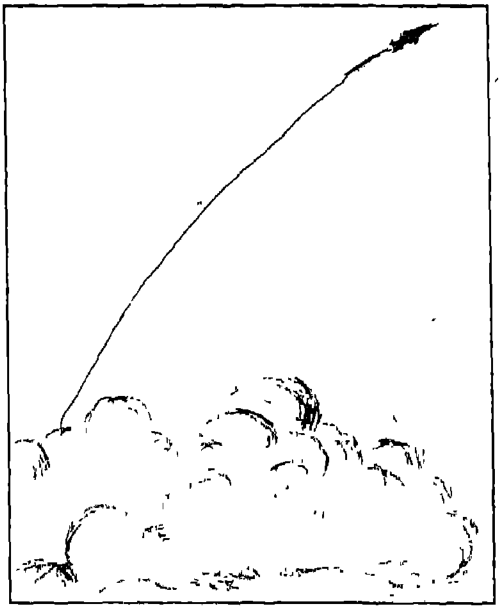
33. Craig (P J) *Organometallic Compounds in the Environment*. John Wiley (1986) 368 pp.

34 Same as in 14 above

35. Same as in 2 above.

The Intriguing Story of the Jet Plane

K.V Gopalakrishnan
Professor
Department of Mechanical Engineering
I.I.T., Chennai 600036



The great explorer, Ferdinand Magellan, took nearly a hundred days to sail across the vast Pacific Ocean. Today, it is routinely criss crossed by modern passenger jet aircraft in a matter of hours. The jet engine (aircraft gas turbine) has given an enormous impetus to the movement of people across countries and continents. Millions of passengers are moved every year by jet planes and families separated by half a world do not feel cut off from each other since they know that they are within a few hours of travel. The jet engine is one of the powerful forces that are inexorably drawing the global community together.

But strangely, such a revolutionary invention had to suffer an enormous amount of delay and obstruction in its development before it took off (literally). The two men who were most responsible for its initial development belonged to opposing nations locked in a bitter war, were unaware of each other's work, but proceeded on remarkably similar lines and met very similar kinds of obstructions. They were Frank Whittle (later Sir Frank) of Britain and Hans von Ohain of Germany. Their story proves that even in this age of Science and Technology, psychological resistance to change and innovation is no weaker than in the centuries past.

The concept of the jet engine was, paradoxically, quite well known and understood long before it reached fruition. Steam turbines have been used for electric power generation and marine propulsion for nearly a century now. Hence it was logical to anticipate the gas turbine as the next step. However, the materials to withstand the high temperatures and stresses encountered in the gas turbine were not available until the 1930's and aerodynamics of the gas flow through the blades was not well understood. But even when these technical obstacles were sufficiently overcome, bureaucratic resistance to the idea proved to be an even greater hurdle in both Britain and Germany

Frank Whittle was born in 1907 in Coventry, U.K. the son of a small machine shop owner. Even as a child he had an obsessive interest in aeroplanes and never thought of any career outside aviation. Poor physical build and health were his handicaps, but by persistent effort he got into the Royal Air Force (RAF) at the age of sixteen At 19, he was selected to attend the RAF College at Cranwell. There he mastered the basics of the science of aviation and also became an expert pilot In his final year in 1928, he wrote a thesis on "Future Developments in Aircraft Design" outlining the principle of what we now call the Turboprop engine, in which a propeller is driven by a gas turbine. Thereafter, the idea never left his mind.

Basically, the jet engine consists of a compressor, a combustion chamber and a turbine (see figure given below). The compressor, (A), spinning at a very high speed, draws in air, compresses it and feeds it to the combustion chamber (B) where the fuel is injected and burnt. The hot gas flowing out from the combustion chamber **is expanded** through a turbine, (C) producing power. The turbine is mechanically coupled to the compressor and drives it. The gas leaving the turbine flows with a high velocity through a nozzle (D) into the atmosphere The reaction to this gas flow propels the aircraft in the forward direction As it has no reciprocating parts the gas turbine is very smooth in operation Since it spins at very high speeds it produces a tremendous thrust for a light engine weight. With its introduction aircraft speeds almost doubled over night.

But with all its advantages, the jet engine had to face tremendous obstacles in its development The basic cause was the conservatism of the human mind, which gets multiplied several fold in the case of Government bureaucrats ! The British Air Ministry rejected Whittle's idea as "unworkable" His patent on the engine lapsed in 1935 for want of a paltry sum of money. But the persevering Whittle and a few intimate friends who shared his enthusiasm founded a private company named Power Jets to develop the idea In 1937 the first prototype engine was tested. The racket that it made frightened even its creator but also elated him by its successful operation.

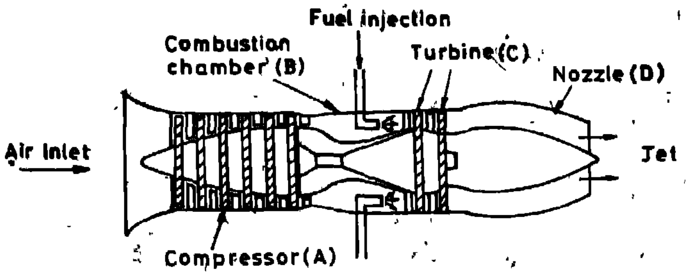


Fig. Schematic layout of a jet engine

The outbreak of the Second World War in September 1939 lent urgency to Whittle's efforts He worked himself into a state of near nervous and physical collapse. In May 1941, Gloster Meteor, the plane fitted with Whittle's engine, was successfully test flown.

Meanwhile, strangely, an almost parallel development was taking place in Germany, with both sides being completely unaware of what the other was doing Hans von Ohain was a brilliant young post graduate student of physics at the renowned University of Goettingen In 1934, he too became interested in the possibility of the aircraft gas turbine The model he constructed however failed. But he had a sympathetic professor who strongly recommended him to Ernst Heinkel, the famed aircraft manufacturer. Heinkel employed von Ohain in 1936 and allowed him to work on his idea — but in total secrecy. The secrecy was necessary partly to protect it from competitors, but even more importantly from government officials, who Heinkel feared would kill the project in its infancy. Later events were to prove that his apprehension was fully justified.

In the initial stages however, von Ohain was luckier than Whittle Though he started some years later than Whittle, the support of Heinkel made all the difference. By early 1939, Ohain could demonstrate his engine successfully. Hitler was shown the engine, but was not impressed. Even the first flight of a jet plane, built around this engine, in August 1939, (a full 21 months earlier than Whittle's model !) failed to enthuse the Fuehrer or most of his airforce officials. The easy German victory over France in May-June 1940 also robbed the work of any urgency However, a few far sighted officials in the German Air Ministry realised its importance and awarded a contract for its development to the famous firm Messerschmitt. This firm too found it no easy task to proceed They had to do it circumspectly against the opposition of the high officers of the Luftwaffe.

Finally, Messerschmitt got the first jet fighter, the Me262, flight tested in July 1942 and by the end of 1943, the plane was ready for mass production. Now Hitler became interested, but wanted it to be converted into a bomber, to retaliate against allied bombing of German cities ! It was a decision of monumental stupidity and set the programme back by nearly a year. Finally he relented and allowed the jet fighter to be produced, which saw action only in early 1945, too late to affect the outcome of the war

Meanwhile in England, Whittle was finding it even more difficult to get his plane accepted, though the combined British and American industrial capacity was far higher than Germany's and these countries were not subjected to heavy bombing But apathy and bureaucratic hindrance were even greater obstacles !

The American firm, General Electric, started taking an interest in Whittle's work in July 1941 and successfully flight tested its model of the jet plane late in 1942 Towards the end of the war the plane went into production but the fighting ended before it could be employed. It was only in the Korean War of 1950-1953 that jet fighters truly came into their own.

But once the value of the jet engine was generally grasped progress was spectacular. Supersonic jet fighters for military applications were quickly developed The first commercial jets, passenger planes, were introduced in 1958 and despite some initial setbacks elbowed out the piston engined planes within a few years A supersonic passenger liner, the Concorde, was also developed. Today, huge jet planes carrying nearly 400 passengers or 100 tons of cargo are common place

The jet engine has also been used to power small and moderate sized ships and in electric power generation

Fame and rewards poured on Frank Whittle, though belatedly, after the War. He was knighted in 1948 and received a cash award of £100,000, tax free. Honorary doctorates were showered on him by Universities. But he had paid a heavy price for success in physical and mental health He sought quiet appointments after the war and finally emigrated to the USA in 1976 There he taught at the US Naval Academy in Annapolis.

Hans von Ohain, belonging to a defeated nation, was not equally lucky with regard to recognition He too emigrated to the USA to work for the US Airforce and teach at the University of Dayton. Whittle and Ohain met for the first time in New York in 1965 and became friends

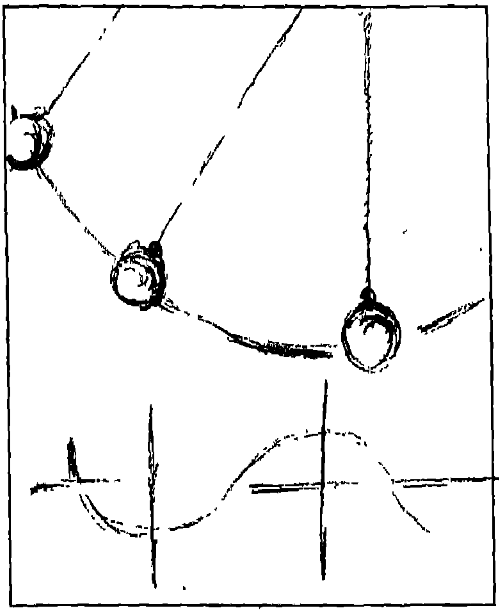
It is fascinating to speculate what would have happened if the development of the jet engine had been better supported in the initial stages in Britain and/or Germany. In Britain, a jet fighter could easily have been built before the outbreak of the war. It's large-scale employment would have denied the Luftwaffe air superiority during the invasion of France in May 1940 Would the invasion then have succeeded ? Even if it had, in the subsequent Battle of Britain, the German defeat would have come about earlier and more easily.

On the other hand, if the German authorities had a better vision than the British, they could have produced operational jet fighters by the beginning of the war They could have easily won the Battle of Britain, inspite of the British possession of radar. Would they then have invaded Britain and would the invasion have succeeded ? Even later, German possession of jet fighters would have undoubtedly stopped the allied bombing of Germany during 1942-1945 in its tracks Would the allied invasion of Normandy in June 1944 have succeeded if air superiority had not been assured ?

In an alternative scenario if both Germany and Britain had been more alert, they both might have had jet fighters right from the beginning of the War. Would that have meant cancellation of any advantage to either side, leading to approximately the same course for the war ? None can answer these questions with certainty ! All that is certain is that the Jet Age, brought about by the work of these pioneers, will take us closer to the day of the United States of the World.

Analysis and Interpretation Skills in Physics of Twelfth Grade Students

V.P SRIVASTAVA
Department of Education in Science and Mathematics
National Council of Educational Research and Training
New Delhi 110016



The purpose of this study is to assess the analysis and interpretation skills in physics of twelfth grade students in India. Though a number of studies have been made in the UK (APU, 1978, Kelly, 1982, Lock, 1986; Lock, 1989; Lock, 1990a; Lock, 1990b; Lock, 1992), Israel (Tamir, 1988), Japan (Kojima, 1974; Matsubara, 1986), USA (NAEP, 1975; NAEP, 1978), Canada (Hobbs et al., 1979), Australia (Parker, 1984) and Singapore (Toh, 1993) to assess the science practical skills of students, little is found in literature about the Indian students. The present work is an attempt in this direction. For this two paper and pencil tasks centered on graphs and set in physics context were administered to 225 students (162 boys and 63 girls) of grade 12 drawn from seven schools affiliated to the Central Board of Secondary Education (CBSE), New Delhi The two tasks were designed to assess the analysis and interpretation skills as defined in the framework of Tamir's taxonomy (Tamir et al., 1992) of practical tasks Within this broad category of, the present study tests the skills of graphing data, determining relationship, interpretation, prediction and formulating a generalization Though the task designed for this study are simple and context familiar to students, the average score obtained in this test is only 38.5% Further, difference between achievement of boys and girls in this test is found to be statistically significant only in prediction skills. Underachievement in science of girls compared to boys have been reported in a number of major studies done in this field in the USA (NAEP, 1978), Canada (Hobbs et al., 1979), UK (DES, 1980; Kelly, 1982) and Australia (Parker, 1984) as well as the First and Second IEA International Science Studies (Comber and Keeves, 1973; Postlethwaite and Wiley, 1992).

It is also found that there is some difference in achievement among schools.

The results obtained in this study clearly reveal the inadequacy of the curriculum prescribed at present in developing analysis and interpretation skills in physics. This raises serious concerns for curriculum developers, planners and Boards of Secondary Education in India Implications of study are also discussed.

Method

The data used in this study was collected through a test comprising two paper and pencil tasks While designing the tasks, the presently used curriculum in physics was kept in mind and the tasks focused on the concepts of physics already taught to students. Text of the tasks is given in the appendix The first task requires to plot a graph using the given data and then answering questions based on this. In the second task, two graphs are given and on the basis of these, a student is required to answer questions designed to test various process skills

Sample

The sample consisted of 225 students (162 boys and 63 girls) of grade twelve drawn from seven schools — six in Delhi and one in Bangalore The mean age of the sample is 17 years 3 months All the schools are affiliated to the same Board — Central Board of Secondary Education, New Delhi and follow the same curriculum Out of seven schools, 3 are Government schools, 3 are Central schools and one a public school. Composition of the sample in a school and type of schools are given in Table 1 For various reasons, name of the schools are not being given — rather schools have been given code as G1, G2, G3, C1 C2, C3 and P (G for Govt. schools, C for Central schools and P for the Public school).

Test Administration

For this a student test booklet was designed similar to that used in IEA Second International Science Study (Kay etal., 1992) and was provided to each student just before the test The test was administered in a batch of 20 to 25 students and each batch was briefed before the test. For each task, the time allowed was 25 minutes. A scoring grid was developed by the author and validated by the teachers In order to minimize the inter-rater variability, all the booklets were marked by the author.

TABLE 1

Composition of the Sample

School	*Mixed Sex or Single Sex*	*Number of Students*			*Average Age of Students*
		Boys	*Girls*	*Total*	
C1	MS	16	09	25	17Y 2M
C2	MS	37	13	50	17Y 5M
C3	MS	15	08	23	17Y 1M
P	MS	26	08	34	17Y 2M
G1	SS	46	0	46	17Y 4M
G2	SS	22	0	22	17Y 3M
G3	SS	0	25	25	17Y 2M
Total		162	63	225	Average age of sample 17y 3m

TABLE 2

Result of the Practical Test

N=225

Process skill	*Mean*	*SD*	*Maximum possible score*	*Percentage score*
Graphing data	1.54	1.03	3	51.3
Determining relationship	1.36	1.04	4	34.0
Interpretation	1.04	0.93	3	34.7
Prediction	0.12	0.32	1	12.0
Formulating a generalization	0.56	0.50	1	56.0
Whole test	4.62	2.40	12	38.5

Result and Discussion

Table 2,3 and 4 summarize the results of this study. Table 2 presents the mean score obtained by the students in various process skills assessed in this study. It is seen that only in two skills i.e. graphing data and formulating a generalization, the average score is more than 50%. The average score in determining relationship is 34.0% and in the interpretation skill, it is 34.7%. The minimum score is found in the prediction skill — it is only 12%. This implies that students found the items of the task testing the prediction skill most difficult. Table 3 presents the achievement of boys and girls in the test. The last column gives the critical ratio calculated to see the gender difference in the process skills under consideration. It is seen that in the whole test, gender difference is statistically not significant — only in the prediction skill, the gender difference is found to be statistically significant at 0.01 level. In fact, in graphing skills, the average score of boys and girls are found to be equal. In the process skills of determining relationships, interpretation and prediction, the average score of boys is more than girls. But in the skill of formulating a generalization, the average score of girls is little more than that of boys although this difference is statistically not significant.

TABLE 3

Achievement of Boys and Girls in the Practical Test

Problem or skill	*Boys Mean*	*N=162 SD*	*Girls Mean*	*N = 63 SD*	*Maximum possible score*	*Critical ratio*
Graphing data	1.54	1.01	1.54	0.96	3	0
Determining relationship	1.43	1.13	1.19	0.66	4	1.97
Interpretation	1.13	0.92	0.81	0.91	3	2.35
Prediction	0.13	0.34	0.08	0.27	1	3.47*
Formulating generalization	0.56	0.50	0.59	0.49	1	0.41
Whole test	4.78	2.44	4.21	0.38	12	1.60

* Significant at 0.01 level

Table 4 gives the difference in achievement in the test among schools. In the whole test, the average score varies from 3.74 obtained in a government school to 6.0 obtained in a private school — the variation is 60.4%. In other skills (excluding prediction), the variation ranges from 66% to 93%. In the prediction skill in which while the average score is as low as 12 variation is 500%. Though there is variation in achievement of students from school to school, but a definite pattern showing correlation between school and achievement of its students does not emerge from this study. In fact, investigation into this aspect requires a separate and detailed study taking into consideration explicitly different variables of the school environment and is not the aim of this study.

Implications

This study has raised serious concerns for science educationists, curriculum developers and Boards of Secondary Education in India It clearly shows that the presently used curriculum of physics practical has failed to develop the analysis and interpretation skills in students up to a reasonable level An analysis of the currently used physics practical curriculum shows that the two main reasons for this poor performance are (1) the type of laboratory exercises used in the coursework, and (2) the nature of assessment presently in practice It is high time that curriculum designers and developers, Boards of Secondary Education take a fresh look at the following elements of the curriculum (1) Instructional Approach, (2) Laboratory exercises, and (3) Assessment of practical work in physics. The author is presently developing a new approach to practical physics which will address to all the three elements of the curriculum mentioned above and will be based on recent advances in the field of Cognitive Science, in general and Tamir's taxonomy of practical skills in particular.

Acknowledgements

The author is grateful to Prof. A.K.

TABLE 4

Differences in Achievement in the Practical Test among Schools

Process skill	*School C1* *N=25*		*School C2* *N=50*		*School C3* *N=23*		*School P* *N=34*		*School G1* *N=46*		*School G2* *N=22*		*School G3* *N=25*	
	Mean	*SD*	*Mean*	*SD*	*Mean*	*SD*	*Mean*	*SD*	*Mean*	*SD*	*Mean*	*SD*	*Mean*	*SD*
Graphing data	1.28	0.96	1.22	1.10	1.43	0.93	2.09	0.78	1.37	1.01	1.91	0.99	1.76	0.95
Determining relationship	1.56	1.10	1.08	1.06	1.96	0.85	1.62	1.07	1.11	0.94	1.36	1.07	1.32	0.73
Interpretation	1.21	0.89	0.84	0.90	1.17	0.87	1.47	0.85	0.78	0.92	1.36	0.78	0.76	0.99
Prediction	0.08	0.27	0.08	0.27	0.30	0.46	0.18	0.38	0.07	0.25	0.05	0.21	0.12	00.32
Formulating a generalization	0.56	0.50	0.58	0.49	0.57	0.50	0.65	0.48	0.41	0.49	0.68	0.47	0.60	0.49
Whole test	4.68	1.95	3.8	2.63	5.43	2.68	6.0	2.05	3.74	2.15	5.36	2.04	4.56	2.21

Sharma, Director, NCERT who interested me in this field three years ago. The author thanks Prof A.N. Maheshwari, Joint Director, NCERT and Prof. K V Rao, Former Head, Department of Education in Science and Mathematics, and Prof R.D Shukla, Head, DESM, NCERT for their encouragement and interest in this work. Thanks are also due to my colleagues, Dr. B.K. Sharma and Shri R. Joshi for helping me in administration of the test.

The author is also indebted to students, teachers and principals of the seven schools for their cooperation in this study.

APPENDIX

Task 1 25 min.

Air enclosed in a hypodermic syringe was compressed in steps keeping temperature of the air constant Data of the experiment is given in the following table:

Volume, V (cm^3)	60	50	40	30	20	10	5
Pressure, P (absolute atm)	1.00	1.13	1.43	1.98	3.00	5.88	11.48

1. Using the above data, plot the pressure v/s volume on a Cartesian graph paper.
2. Suggest a relation which best describes the variation of P with V in this experiment. Can you confirm this relation using the above data

   ....

   ....

3. Would you expect air to follow the above relationship under extremely high pressures ? Give reasons for your answer.

   ....

   ....

Task 2

A stone was dropped with initial velocity of zero and its distance (s)- time (t) data was collected. This data was used to draw distance-time graph (Fig 1) and distance - time^2 graph (Fig.2) for this motion.

Study the two graphs carefully and answer the following questions·

1. Is the stone moving with a constant velocity ? State reasons for your answer

   ....

   ....

2. Is the stone moving with a constant acceleration ? State reasons for your answer

   ....

   ....

3. (a) How s varies with t^2?

   ....

   ....

(b) Determine a relationship between s and t^2.

....

....

4. Can you obtain the value of acceleration due to gravity, 'g' from the above relationship ? If yes, calculate the value (Show all calculations).

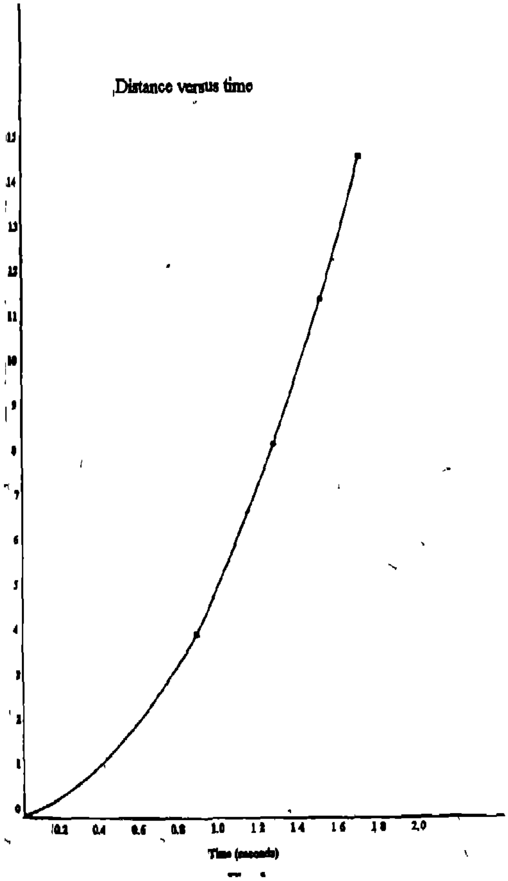
....

....

5. Write a general equation which describes such motions

....

....



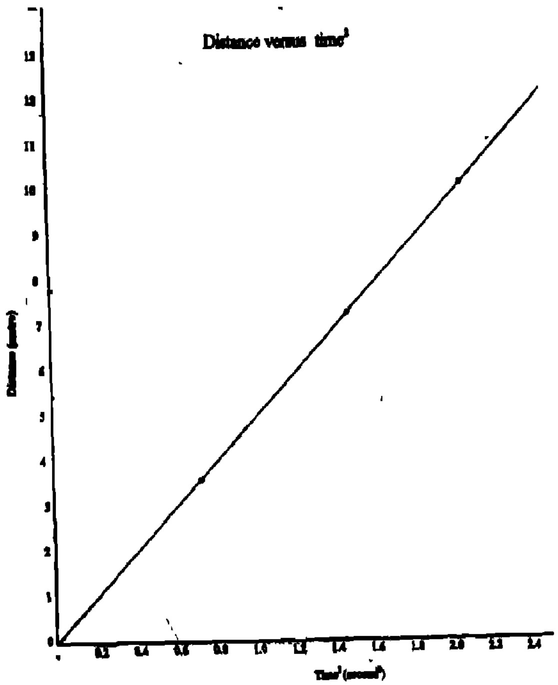


Fig. 2

REFERENCES

APU (Assessment of Performance Unit) (1978) *Science Progress Report*, 1977-78, London, Elizabeth House.

Comber, L.C & Keeves, J P. (1973). *Science Education in 19 Countries*. New York: Wiley

DES (Department of Education and Science) (1980). *Girls and Science*. HMI series, London HMSO

Hobbs, E D. Boldt, W.B. Erickson, G L. Quelch, T P, & Sieben, G A (1977) *British Columbia Science Assessment 1978. General Report No 1 Vancouver*, British Columbia; Ministry of Education

Kay, C, Rosier, M & Tamir, P, (1992). Instruments and supporting materials for practical skills testing in science *Studies in Educational Evaluation* 18,319-353

Kelly, A (1982). Why girls don't do science ? *New Scientist*, 497-500.

Kojima, S (1974) On the measurement of practical abilities in science in Japan. *Comparative Educational Review*, 18,263-267.

Lock, R.J. (1986). Assessment of science practical skills in 15 year olds. *Ph.D Thesis*. University of Leeds.

Lock, R.J (1989) Assessment of practical skills Part I. The relationship between component skills *Research in Science and Technological Education*, 7,221-233.

Lock, R.J (1990a) Assessment of practical skills. Part II: Context dependency and construct validity *Research in Science and Technological Education*, 8,35-52.

Lock, R.J (1990b). Pupil ability and practical skills performance in science *Education Review*, 42,65-76

Lock, R.J (1992) Gender and practical skill performance in science. *Journal of Research in Science Teaching*, 29,227-241

Matsubara, S. (1986). *Summary of practical results in Japan*. SISS Document S86-01, Hawthern Australian Council of Educational Research.

NAEP (National Assessment of Educational Progress) (1975). *Selected results from the national assessment of science Scientific principles and procedures*. Education Commission of the States, Washington, DC

NAEP (1978). *Three national assessments of science . Changes in achievement*, 1969-77 Commission of the States, Washington, DC.

Parket, L. (1984) Science for all ? The role of science teachers in eliminating gender differences in access to scientific knowledge *Australian Science Teacher's Journal*, 30,21-4

Postlethwaite, T N., & Wiley, D E (1992). The IEA Study of Science II: *Science Achievement in Twenty-three Countries*, Oxford Pergamon.

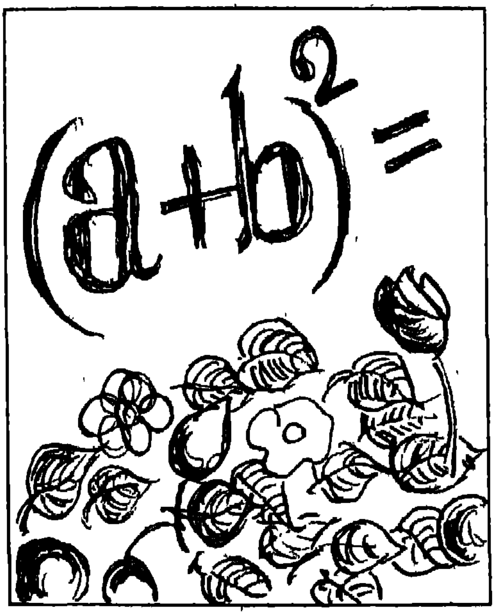
Tamir, P. (1988). Science practical process skills of ninth grade students in Israel *Research in Science and Technological Education*, 6,117-265.

Tamir, P ; Doran, R.L & Chye, Y.O. (1992). Practical Skills Testing in Science. Studies in Educational Evaluation, 18,263-275.

Toh, Kok-aun, (1993). Gender and practical tasks in science *Educational Research*, 35 (3), 255-265.

Teaching of Mathematical Concepts at Upper Primary Stage

Dr (Mrs) Harinder Nanda Mahajan
Research Scientist (UGC)
Education Department
Delhi University
Delhi 110 007



Understanding of concepts is basic to further learning, transfer and problem solving. It involves more than definition of a concept or recognition of common examples A student should also be able to represent or recognize a concept in different modes of representation or its application in different settings, translate from one mode to another, generalize to other examples, recognize its non-examples and explain why, abstract its properties other than those used in its definition, compare and contrast concepts and integrate concepts. These need to be emphasized in teaching, learning and evaluation for attainment of higher level objectives such as transfer and problem solving. In this paper we elaborate on these for teaching of mathematical concepts, at upper primary stage only. As teaching of concepts depends on the content, the developmental stage of the learner and his previous experiences, we would mainly emphasize activities which are feasible in Indian setting.

Developmental Stage of the Child

Piaget suggested four stages in development of the child: sensori-motor before appearance of language at about two years of age, pre-operational which precedes real operations about 2-7 years, concrete-operational about 7-12 years of age and formal-operational at twelve plus. Further experiments and research has suggested that characteristics suggested by Piaget for the formal operational stage do not begin to emerge until 14 or 15 years of age in many pupils. These suggest that most pupils at upper primary stage are at concrete operational stage and there is a need for concrete referrents in teaching of mathematics. It does not imply that mathematics teaching always requires concrete apparatus till the full emergence of formal operations. It can be replaced by actions carried out in the mind on the basis of prior knowledge underlying concrete manipulations.

Previous Experience

Mathematics learning largerly consists of building understanding of new concepts onto previously understood concepts. There is thus a need to check students understanding of concepts which are prerequisites for learning of the new concepts. Children at the end of primary stage are expected to have understanding of the concept of place value and zero as a place holder for reading and writing of whole numbers; four fundamental operations on whole numbers, fractions and decimals; percentage; geometrical shapes like circle, triangle, square, rectangle; line segment, line, ray and angle; measurement of length, angles, capacity, time and temperature. However, tests given at the beginning of Class VI by the author in Delhi government schools reveal lack of adequate understanding of these by most students. There is thus a need to assess understanding of these and take remedial measures before teaching topics for which these are prerequisites.

Empirical Reality in India

In most schools in India it would not be possible to use commercially produced concrete materials for individual students, videotapes or projectors. However, it is not a great handicap. Activities requiring use of simple concrete materials llike ropes, matches, paper cutting, paper folding, drawing on geopaper, graph paper can be used by individual students. Demostration aids like models, charts, drawings can be used to provide visual experiences for abstracting a concept and its properties. Teachers can also draw students attention verbally to objects in the environment or situations in daily life which model the concept and ask them to answer questions which would enhance understanding of the concept

What is a Concept ?

It is difficult to define a concept and we would not delve into it We may think of a concept as formation of an idea or mental image which is labelled by a word or symbol. Skemp (1986) distinguishes between two types of concepts primary and secondary. Concepts which are abstracted from sensory or motor experiences are called primary concepts and concepts which are abstracted from other concepts are called secondary concepts.

The mental image for primary concepts is first formed by having sensory or motor experiences of an object/set of objects, its attributes or relations between an attribute/attributes of two or more objects e.g. concept of number "four", >, =, <, 7+8, 3 × 4, line segment, angle, triangle, circle, length, area, symmetry, congruence, similarity, These are then expressed by a word or symbol. After a number of experiences, these are abstracted and become an element of thought detached from concrete reality. Some concepts may later be left undefined e.g. concept of a point, line and plane or defined in terms of other concepts e.g. concept of a circle may first be formed by having sensory experiences nd later may be defined as a figure ormed by a set of points in a plane quidistant from a fixed point

Secondary concepts are derived rom other concepts in a number of ays

- ☐ by extending a concept to a more inclusive concept called super concept e g whole numbers to integers.
- ☐ generalizing a concept e g generalisation of arithmetical numbers as a literal number, a class of relations "equivalent to" which encompass equal to, congruence, similarity with class properties of reflexivity, symmetry and transitivity.
- ☐ differentiating a concept into sub-concepts called coordinate concepts (Merril and Tennyson, 1977) by restricting measures of some attribute to certain range of values e g differentiating angles into acute, obtuse and right angle etc, or relations between measures of some attributes e.g. triangle into scalene, isosceles and equilateral triangles
- ☐ comparing an attribute/attributes of two or more objects e g larger than, equal to, smaller than, fraction, ratio, percentage, congruence and similarity of geometrical shapes, measure of an attribute
- ☐ a rule relating two or more concepts e.g chord of a circle is a line segment which connects two points on a circle or factor of a number is a number which divides it exactly
- ☐ transforming a concept by doing something to it e.g multiplying a number itself n times to get its n^{th} power

Understanding of Concepts

A student understands a concept if he is able to

- ☐ label or define a concept
- ☐ represent a concept in many ways or apply it in many situations
- ☐ translate a concept from one mode of representation to another
- ☐ recognize its examples in which many variable features vary or give new examples or generate examples with specified properties.
- ☐ recognize its non-examples and explain why
- ☐ abstract its properties other than those used in defining it
- ☐ compare and contrast concepts by recognizing similarities and differences between sub concepts of a concept and inclusive relations between a concept and its super concept
- ☐ integrate concepts with previously learned concepts.

All of these may not be relevent or important for a concept depending on its nature, newness, complexity and stage of learning of the student

Teaching of Concepts

Teaching of concepts for understanding needs to be planned carefully analyzing it for prerequisites or sensory experiences that would enable students to abstract a concept· the examples and non-examples that should be used to enable students to generalize to other examples in which variable attributes vary and discriminate it from non-examples in which a critical feature is missing, deciding on activities which would help students in abstracting its properties, deciding on concepts to which it should be compared or constrasted from or be integrated with assessment of its understanding and review while teaching other concepts based on it or topics to which it can be applied.

Introducing a Concept

We need to ensure that students have the prerequistes of a concept before labelling or defining a concept Pre-requisites of a concept depend on its nature

Sensory motor experiences need to be provided for formation of primary concepts e g. angle, circle, area, volume, symmetry, congruence. A large number of experiences are necessary for formation of such concepts and their abstraction as elements of thought detached from concrete reallity Experiences may be provided by engaging students in activities involving use of manipulatives, visual experiences by means of videotapes, charts, models, drawings or drawing their attention to familiar objects in the environment before identifying a concept by a label or symbol. These are crucial for language to make sense.

Secondary concepts should first be analyzed to understand its contributory concepts and for each of these its contributory concepts and so on till we reach the experiences or concepts which students can be assumed to have had or understand adequately. These need to be reviewed or assessed before introducing a concept based on these depending on time gap in their teaching and complexity For example, concept of prime number is taught just after the concept of a factor, only a review with examples emphasizing special cases e.g. one and number itself as a factor of every number may be all that is necessary. But, before introducing the concept of a rational number, a quizz may be desirable on its prerequisites viz. fractions and integers which were taught long ago and are more difficult.

Algebraic concepts at upper primary stage which are generalizations of arithmetical concepts of number and operations on them need to be preceded by activities which facilitate transition to algebra Activities which require students to generalize from patterns, think about a numerical relations in a situation from many examples, discuss it in everyday language and finally represent it with letters or notation like □ and △, teaching arithmetical numbers in ways which enhance their understanding and generalize to more general concepts e.g concept of area models for multiplication of numbers which generalizes to literal numbers and their combinations with numbers For description of some such activities see Davis (1985), Kieran, Battista and Douglas (1991), Peck and Jencks (1988), Pegg and Redden (1986)

Representation of a Concept

A concept should be presented in many modes or settings to enhance its understanding and develop conceptual schemes helpful for further learning

Bruner (1966) suggested three modes of representation of mathematical concepts inactive (physical representation), iconic (pictorial representation) and symbolic (written symbols). Lesh and Landau (1983) expanded it into five

— real world situations, manipulatives, pictures, spoken symbols and written symbols

Desirable modes of representation for a concept would depend on its nature, newness, complexity and previous experiences.

It is desirable to represent complex and new concepts in many modes to enhance its learning and further learning based on it. For example a fraction like 2/5 may be represented as two parts of a cake which has been divided into five equal parts, on a number line, constituting two parts of a rectangle which has been divided into five equal areas or four coins of a picture of a collection of ten coins or picture of □s or □s so arranged in two rows of five each or division of number two by five and may also be written as two-fifths. Similarly concept of a parallelogram may be represented by its model, pointing to its examples in the environment, drawing it on the blackboard, engaging students in activities like drawing it on geopaper, graph paper, making it by arranging two congruent triangles together

Simple secondary concepts may be represented by pictures and verbally if students have adequate mastery of contributing concepts e.g. concepts like prime numbers, chords of a circle, diagonals of a quadrilateral

New representations for already familiar concepts may be introduced which are useful for more inclusive or general concepts e.g. representation of natural numbers on a number line which can later be used for integers, fractions, decimals, rational numbers or use of area models for multiplication of natural numbers which can later be used for multiplication of fractions, decimals and literal numbers and sum or difference of literal numbers or literal numbers and natural numbers.

Translation of a Concept Given in One Mode to Another

Translation of a concept expressed in one mode to another besides enhancing understanding is an important capability needed in day-to-day life e.g. writing of amount of money in words and figures, interpreting or reading tables and graphs given in ready reckoners, newspapers, books etc. It is also an important aspect in applications and problem solving which invariably require translating a word problem into a mathematical sentence, table or diagram. Many opportunities and activities should be provided to students to translate from one mode to another. Questions or activities like the following may be used:

☐ write a given amount of money in words and figures

☐ represent and read whole numbers, integers, rational numbers on a number line

☐ represent and read multiplication of whole numbers, fractions, decimals and literal numbers as areas on a geo or graph paper

☐ translate word problems involving fundamental operations or numbers in arithmetical sentences

☐ make equilateral, scalene or isosceles triangles using matches

☐ draw geometrical concepts like parallel lines, triangles, parallelograms on geo paper, graph paper, with a ruler.

☐ translate an expression given in

words in an algebraic expression
- ☐ translate a word problem onto an algebraic equation
- ☐ draw and read graphs
- ☐ read tables to find specific information
- ☐ measure perimeters of irregular figures
- ☐ draw a cuboid, cone, right circular cylinder and label its dimensions
- ☐ express formulae for perimeters, areas, volumes of regular geometrical shapes given in words in symbols and vice versa
- ☐ draw regular figures with given perimeter or area
- ☐ give directions for copying simple figures on a paper to someone who cannot see the figure himself
- ☐ draw and read maps of reaching school from different points nearby

Use of Examples

Many characteristics vary among class members of a concept these are called variable attributes. It is important to give many examples in which variable attributes vary So that students can generalize to other examples For example in teaching concept of a triangle models or drawings that vary in size, orientation, length of sides and angles should be presented. Many students who have only seen squares with sides parallel to the edges of a textbook or blackboard, cannot recognize squares like ◇ or draw a square on the hypotenuse of a right angled triangle whose legs are parallel to the edges of a paper The students may also be asked to give examples from the environment to which other students can react

The students may be asked to generate examples of concepts with which they have previous experience using analytical thinking Questions or activities such as the following may be used:

- ☐ write all possible numbers, smallest number, largest number using specified digits (using each digit once only)
- ☐ write numbers which are 1 more or less than a number with special emphasis on numbers which end in nines or zeros
- ☐ generate stories in which specific computations such as

  $$2150 \times 1\ 5, \frac{1}{2} \times \frac{2}{3}, \frac{1000 \times 5 \times 2}{100}$$

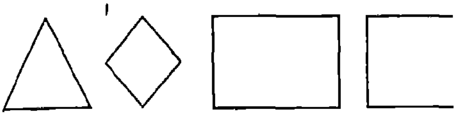
  are required
- ☐ write two numbers whose LCM is 12.
- ☐ write two numbers whose HCF is 1
- ☐ make a cuboid using 24 unit cubes.
- ☐ make triangles giving specified numbers of matches and describe how many different triangles can be made and their type

Characterization of a Concept

A concept is characterized by attributes that all members of a class possess These are called critical attributes Students attention may be drawn to these by listing them and/or providing practice on examples in which a critical feature is missing so that they can discriminate non-examples from examples Questions like the following may be asked

- ☐ Which of the following are not prime numbers? Place an X against them and explain why
  1, 2, 4, 7, 9
- ☐ Name the property that prevents the

following from being called a square



- ☐ Students gave the following examples of a triangular object open compass, samosa, mountain Why, are these wrong ?
- ☐ For each of the following, place an X against unlike terms and explain why ?

  6x and x
  x^2 and 2x
  2x and 2y
  xy and yx

Exploration of Properties of a Concept

A concept has many properties other than those used in defining it. The students may be asked to explore these by observation, measuring, paper cutting and folding, rotation about a point or analytical thinking Questions or activities such as the following may be provided and answers of different students discussed in class

- ☐ asking the number of sides, diagonals, vertices and angles in different types of polygons
- ☐ measuring angles of different triangles, quadrilaterals and finding their sum
- ☐ drawing triangles with specified angles including set of angles for which the figure cannot be drawn (with sums greater than 180)
- ☐ making triangles using sticks of speified length including a set of sticks with lengths for which a triangle cannot be made
- ☐ exploring the properties of quadrilaterals. For example, a parallelogram by measuring its sides and angles, cutting it along the diagonal and comparing the triangles or making a rectangle from it by a suitable cutting and rearranging it
- ☐ finding lines of symmetry by cutting and paper folding
- ☐ making models e g a cuboid using 24 unit cubes or open boxes by cutting corners from same sized grid papers and showing these in class for observation of properties
- ☐ estimating measurements or answers to computations involving fundamental operations.

Comparison and Contrast of Concepts

A concept should be related to superordinate concepts which may have been formed by extending it and discriminated from co-ordinate concepts which may have derived from it Questions pertaining to following may be asked

Compare Different Examples of a Concept

- ☐ Compare the following by writing appropriate symbol, >, = or < in ☐

$$61 \;\square\; 16, \quad .5 \;\square\; \frac{1}{2}, \quad \frac{1}{6} \;\square\; \frac{1}{5}$$

$$-2 \;\square\; -4, \quad .333 \;\square\; \frac{1}{3}, \quad \frac{2}{3} \;\square\; \frac{3}{5}$$

$$.5 \;\square\; \frac{15}{100}, \quad \frac{12}{16} \;\square\; \frac{3}{4}$$

- ☐ Find the largest/smallest angle, length, area, volume given examples of two or more of these

Discriminate Examples of a Concept from Non-examples of Coordinate Concepts

☐ Which of the following variables are inversely related, place a ✓ against them.

(a) amount of commodity and its cost
(b) number of persons employed to complete a work and time taken to finish it
(c) speed of a car and distance it would travel in a specific time.
(d) speed of a car and time taken to cover a specific distance.
(e) Number of similar towels hung in sunshine and time taken to dry them

☐ In what way are a rectangle and square (a) similar, (b) different

☐ In what way are an equilateral triangle and square (a) similar, (b) different

☐ Which of the following are like terms, place a ✓ against them

2x, 3x
5x, 5y
x, 2x
xy, yx

☐ Which of the following are true for all values of x, place a ✓ against them

(a) $x+3 = 5$
(b) $2(x+1) = 2x + 2$
(c) $x \times 0 = 0$
(d) $2x + 3 = 3x + 5$
(e) $(x - 2)^2 = x - 4x + 4$

Recognize Inclusive Relations between Concepts

☐ Is any whole number an integer ?

☐ Is any parallelogram a rectangle ? If no draw such a parallelogram ?

☐ For following numbers, write W for whole numbers, I for integers, F for fractions, D for decimal numbers and R for rational numbers. More than one of these may be applicable, write all of them

$\frac{1}{2}$, .54, -3, 7, 0, 1, 333 49422422.

☐ Name different types of quadrilateral for which the following properties are true using Q for any quadrilateral, S for a square, R for a rectangle, Rh for a rhombus, P for a parallelogram and T for a trapezium More than one of these may be correct, write all of them

(a) one pair of opposite sides are parallel
(b) both pairs of opposite sides are parallel
(c) opposite angles are equal.
(d) all sides are equal.
(e) all angles are right angles
(f) both pairs of opposite sides are equal

Integration of Concepts

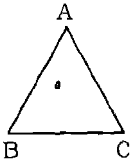
A systematic review of concepts can be build in by integrating concepts with concepts learned earlier which enhances their retention and understanding

Provide a Review of Concepts Learned Earlier

☐ Give as many situations as you can where a person needs to use percentage

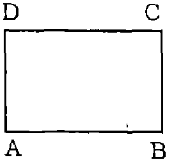
☐ For the adjacent figure

(a) name all the angles
(b) name all the line segments
(c) measure the length



of all line segments
- (d) measure all the angles using a protractor

☐ ABCD is a rectangle
- (a) name a pair of parallel lines
- (b) name a pair of perpendicular lines



☐ Give all the properties of a square (different answers may be desired at different times, e g after teaching of the concepts of congruence, symmetry). Integrate it with concepts in other topics

☐ If the sides of a square are increased by 10%, what would be the percentage increase in its (a) perimeter, (b) area

☐ If the length of edge of a cube is doubled, how would its volume change.

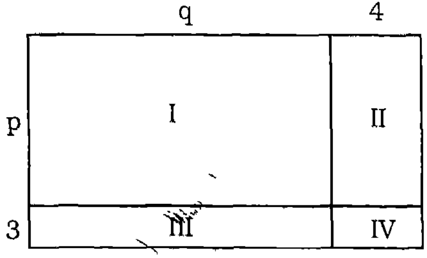
☐ Sides of a triangle are in the ratio 1. 2 3 and its perimeter is 24 cm. Find the sides.

☐ Find the cost of tiling a floor whose length and breadth are 4 and 3 metres respectively The cost of tiling it is Rs. 90 per square metre

☐ Which of the following variables are directly proportional? Place a ✓ against them
- (a) circumference of a circle and its radius
- (b) area of a circle and its radius.
- (c) length of an arc of a circle and angle subtended by the arc at the centre.
- (d) area of sector of a circle and angle subtended by the sector at the centre.

☐ Cut a rectangle along the diagonal and rearrange the triangles with equal sides adjacent to each other, trace it on a paper
- (a) How many figures can you get by rearranging the pieces?
- (b) Name them
- (c) Can you tell without measuring which will have the smallest perimeter, largest perimeter?
- (d) Can you tell without actual measuring which would have largest area, smallest area?

☐ For the figure given below, represent its area (a) in terms of length of its sides (b) as sum of areas of I,II, III and IV



☐ Represent (a+b) (a+b) by a diagram and show that $(a+b)^2 = a^2+2ab+b^2$

☐ Write a paragraph on how mathematics is useful to a person in his day-to-day life

☐ Write a paragraph on how mathematics is useful to a shopkeeper/ farmer/house wife

Assessment of Understanding of Concepts

Understanding of concepts needs to be emphasized in testing to motivate students to pay attention to it, and learn from it The tasks for assessment should differ from those used in teaching to ensure they are testing understanding and not memory e.g. asking students to define in their own words or recognize paraphrased definitions, using examples and non-examples different from those used in teaching, abstract properties of different concepts by using similar techniques etc

It is not necessary to assign separate tasks to assess each aspect of understanding. It is advisable to design a single task that covers several aspects It is also not necessary to assess all aspects or all students or formally by a quiz or test at all times Problems at different levels of involvement and for a small group or whole class can be created Exploration of properties of concept can be done in small groups

The aspect of conceptual understanding to be tested should be selected according to previous experience and developmental level of students. Further these should be consistent with methods of teaching

In monitoring students understanding of concepts a distinction may be made between concepts or aspects of concepts for which mastery should be the aim, e g, concept of coefficient of a term, like terms, power of a literal number etc. and adequate mastery of concepts which develop over time, can be extended further and large individual differences have been observed in ages at which they are mastered, e g concept of place value, fundamental operations on numbers

Review of Concepts

Concepts would be retained only if they are reviewed systematically while teaching concepts based on them and providing opportunities which require their application while teaching other topics

REFERENCES

Bruner, Jeromes (1966) *Towards a Theory of Instruction* Cambridge, Mass Harward University Press.

Davis Robert B (1985). ICMS - 5 Report "Algebraic Thinking in the Early Grades" *Journal of Mathematical Behaviour,* 4, 195-208.

Kieran, Carolyn, Micheal T.Battista and Donglas H. Clements (1991). "Helping to Make the Transition to Algebra", *Arithmetic Teacher,* 74, 49-51

Lesh, R and M Landau (1983) *Acquisition of Mathematical Concepts and Process,* New York : Academic Press.

Merril, M.D. and Robert D. Tennyson (1977) *Teaching Concepts . An Instructional Guide,* Engle Wood Cliffs, New Jersey : Educational Teachnology Publications

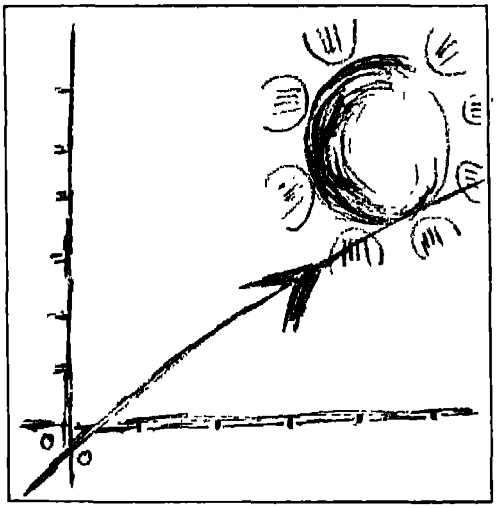
Peck, Konald M and Stanley M , Jeneeks (1988) "Reality, Arithmetic and Algebra", *Journal of Mathematical Behaviour,* 7. 85-91.

Pegg, John and Edward Redden (1990) "Procedures for, and Experiences in, Introducing Algebra in New South Wales", *Mathematics Teacher,* 83, 387-391

Skemp, Richard R (1986) *The Psychology of Learning Mathematics,* London, Penguin Group.

Scientific Attitude and Its Relationship with Academic Achievement at Higher Secondary Level

DR G C BHATTACHARYA
Sr. Lecturer in Education
Banaras Hindu University
D-34/66, Ganesh Mohalla
Varanasi 221 001, U P



The time has come when science is going to be an indispensable part of our life and living styles in the rural as well as urban sectors and therefore, scientific outlook will be essential for all members of the society to get rid of a number of irrational and superstitious belief, dogmas and faith in obscurantism. As such, a rational and just society requires development of scientific temper among individuals, especially among the adolescent learners for progressive growth and modernisation All well flourished and flourishing civilizations of the world, in this way, may be designated as the brain children of the mankind possessing scientific attitude and inventive curiosity It is true to say that the scientific way of looking at things and thinking logically as well as independently on any problematic situation, may enable one to find out desired solution while marching ahead on the path of innovation and exploration Through this process one may be educated in true sense Since education aims to bring rationality in thinking and power of judgement among human beings, all our educational endeavours eventually are concerned with inculcation of an ability to think logically and develop skills desirable to make scientific observation and analysis in life among the young learners, so that they may be able to avoid ragged traditions and use scientific deduction to solve the various problems of their own life as well as of the society.

In this way, science may become a way of life and enable individuals and societies to cope with the problems likely to arise in science dominated future due to its significant role in the field of inventions and innovations, discovery of new facts and truths, for explaining and elaborating old facts and findings in a new way, analysing causes behind natural and supernatural phenomena, finding out solutions to the ever increasing problems of human life especially on account of narrow feelings and selfishness, searching out probable solution of the problems of resource crisis and environmental pollution as well as degradation of social and life-style norms and values etc.

All these and similar innumerable problems are imposing a great challenge before the unity and integrity of mankind as well as existence of human race. To face these challenges with courage and vigour, development of rational outlook and scientific attitude seems to be of supreme importance

Science as a process, adopts a specific mode of enquiry through the scientific method which combines the inductive and deductive thought processes, synthesis of observational fact and figures with reasoning and analysis for purposeful fact finding as well as verification of the presuppositions. At the same time, as a product, it forms a systematised body of knowledge obtained through a series of a large number of empirical observations, but in the both forms, the fundamental part and functionality is scientific attitude

Thurstone (1929) defined attitude as the sum total of man's inclination and feelings — prejudices and biases, preconceived notions, ideas, fears, threats and convictions about any specific topic The behavioural part was added in this definition later on. Allport (1935) stated it as a neutral and natural state of readiness, organised through experiences, exerting a directive or dynamic influence upon individual response to all objects and situations with which it is related.

Doob (1947) considered it as a bipolar concept, since two people may feel the same amount of effect towards an object but may behave differently or may have different belief.

Cheim and Evans (1948) discussed over the issue further and took it as a multidimensional concept Equal favourability and cognition may not cause equal belief and action Thus besides cognition, belief and behaviour are the other dimensions of attitude. As such, the attitude concerned with science, scientific method and temperament, analysis etc may be stated as scientific attitude.

Dictionary of Education (1972) defines Scientific Attitude as a set of emotionally toned ideas about science and scientific method and related directly or indirectly to a course of action In the literature of science education, the term implies such qualities of mind as intellectual curiosity, passion for truth, respect for evidences and appreciation of the necessity of free communication in science

Therefore, scientific attitude is invariably concerned with open mindedness, desire for accurate knowledge, confidence in the procedures for seeking knowledge and having a faith in the use of verified knowledge to fetch solution of the problems, rationality, curiosity, objectivity, aversion to superstitions etc., the conceptual criteria, in terms of which academic development may also be elaborated.

Jain (1967) while constructing a scientific attitude scale for Indian youth, selected four domains of intellectual, affective, connective and metaphysical and psychological abilities which to some extent are all concerned with power of expression, knowledge-application, communication, socialisation and commitment to acquire knowledge in spite of problems, the basic dimensions of academic attainment.

Here, intellectual domain is related with belief in cause and effect relationship, searching sufficient evidence and data to come to a conclusion and arousing intellectual curiosity. The affective domain is concerned with respecting others in data, production and its verification, preparedness to share findings with others and believing in goodness of inventions Similarly, the connative aspect is related with intellectual honesty, testing logical conclusions and withholding judgement till its further verification. The metaphysical and psychological domain is related with freedom from superstitions, prejudices and fatalism.

Considering the aspects and domains of the two concepts, they seems to be related internally but now a days, since a set of marks obtained by a student in a certain examination is often taken as an indicator of academic achievement, establishment of relationship between the two variables with a certain degree of confidence become essential, so that instead of academic achievement scores, if desired, test of scientific attitude could be included in all admission and selection tests to assess even those applicants for admission who have not scored a certain percentage of marks in aggregate as well as in the science subjects in the last qualifying examinations. This may help to avoid the dilemma of existing double testing norms.

Considering the above rationale, the objectives of the study were finalized in the following pattern·

Objectives

To find out·

0. 1= Correlation between cognitive domain of scientific attitude and academic achievement of higher secondary students.

0. 2= Correlation between affective domain of scientific attitude and academic achievement of higher secondary students

0 3= Correlation between psycho-motor domain of scientific attitude and academic achievement of higher secondary students

0.4= Relative contribution of cognitive, affective and psychomotor domains of scientific attitude towards academic achievement of higher secondary students

On the line of above objectives, the following hypotheses were framed in null form for verification.

Hypothesis

There is no significant correlation between:

Ho.1= Cognitive domain of scientific attitude and academic achievement of higher secondary students,

Ho.2= Affective domain of scientific attitude and academic achievement of higher secondary students,

Ho.3= Psycho-motor domain of scientific attitude and academic achievement of higher secondary students,

Ho.4= There is no significant contribution of cognitive, affective and psychomotor domain of scientific attitude towards academic achievement of higher secondary students.

The study was delimited on the grounds of urban higher secondary male students. The students studying at first year (Class XI) of recognised higher secondary schools and intermediate colleges situated in the urban area of Varanasi city were included in the study sample The schools were selected randomly and the students who have opted science were specifically taken into consideration. For measuring academic achievement, the marks obtained by the students in their secondary (or high school) examination were taken into account.

The ex-post facto design was decided to be used, as in this study, instead of creating or manipulating the treatments, effect of a naturally occuring treatment was to be observed and examined, especially in terms of relationship between the two variables under observation.

Sample

The study sample consisting of the higher secondary students was selected accidentally, out of five randomly selected schools. A sample of 120 male students found present in the class during data collection period were selected for the purpose of investigation

Tool

The Scientific Attitude Scale (Psychomotor, Affective, Cognitive Questionnaire) developed by. Singh (1988) was selected to measure the scientific attitude of the students.

Data Collection

The Scientific Attitude Scale was administered personally and the responses obtained were scored using the prescribed scoring key After preparation of the master chart, the concerned achievement scores of the students in their high school examination were compiled on the chart and relevant parametric statistical measures were computed

Results and Discussion

The results obtained were analysed objective wise and the levels of significance etc. is presented in the Table 1

The Table 1 represents the value of r=0.756 as obtained between the cognitive domain and academic achievement of the higher secondary students which was found significant at .01 level

TABLE 1

Relationship between Cognitive Domain of Scientific Attitude and Academic Achievement

Varibles	*N*	*Coefficient of Correlation*	*Level of Significance*
Cognitive Domain Academic Achievement	120	r=0 756	Sig at 01 level

of confidence. Therefore, the null hypotheses (Ho.1) according to which there is no significant correlation between the cognitive domain of scientific attitude and academic achievement, stands rejected

This indicates that both the variables are related with each other and as such those who scored better in the cognitive domain of scientific attitude, may also achieve better academically. In other words, development of the cognitive domain of the scientific attitude may help in higher achievement in academic disciplines to the students of higher secondary level.

Similarly, the relationship between the other domains of scientific attitude and academic achievement were also obtained. The relationship with affective domain is presented in the Table 2 below:

The Table 2 also indicates that the Academic Achievement and affective domain of scientific attitude is correlated significantly because the value of r thus obtained is as high as to be significant at 01 level of confidence. Therefore, the null hypotheses (Ho.2) which states that there is no significant correlation between the affective domain of scientific attitude and academic achievement, stands rejected

This also obviously clarifies that the two variables are highly correlated with each other and thus the higher academic achievement of the students may be considered as the indicators of better scientific attitude in terms of its affective domain

In the same way, an attempt was made to determine the correlation between the psychomotor domain of scientific attitude and the academic achievement of the higher secondary students and the results thus obtained is presented in the Table 3.

The results produced in the Table 3, indicates the product moment coefficient of correlation between the psychomotor domain of scientific attitude

TABLE 2

Relationship between Affective Domain of Scientific Attitude and Academic Achievement

Variables	*N*	*Coefficient of correlation*	*Level of Significance*
Affective Domain Academic Achievement	120	r=0.770	Sig. at 01 level

TABLE 3

Relationship between Psychomotor Domain of Scientific Attitude and Academic Achievement

Variables	*N*	*Coefficient of correlation*	*Level of Significance*
Psychomotor Domain Academic Achievement	120	r=0.773	Sig at 01 level

and academic achievement of the students at higher secondary level which is as high as to be significant at .01 level of confidence Thus, the null hypothesis (Ho 3) in which it was recorded that there is no significant correlation between psychomotor domain of scientific attitude and academic achievement, stands rejected

This table also indicates the high positive relationship between these two variables. Since, all the three domains of scientific attitude are found highly correlated with academic achievement in a positive way, it could safely be concluded that development of the scientific attitude among the students studying at higher secondary level may necessarily facilitates better academic achievement.

Such a result is in tune with the findings of Golwalkar (1978) who had obtained similar type of relationship in science subjects. Baker (1985) in contrary, found that the middle school students with A and B grades in science had developed a negative attitude towards science whereas those with C and D grades had a more positive attitude. He suggested two possible reasons for such unexpected results· (i) higher ability middle school students may have found science as a boring one, which has adversely affected their attitude, and (ii) the scientific attitude inventory may not be valid for the middle school students as they perhaps could not follow the items well At the same time, it is also possible that their scientific attitude may not develop well at this stage. To avoid such of a situation, the higher secondary students were selected so that they may possess well developed scientific attitude and also be able to follow the items of the scientific attitude scale. They at this stage, must be much critical minded, respectful to the evidences, honest, objective in decision making, open-minded and with enquiring mood which are also the qualities essential for better academic achievement. This may be a strong reason of obtaining a high, positive and significant relationship.

To determine the relative contribution of the cognitive, affective and psychomotor domains of scientific attitude towards academic achievement multiple R and R^2 were computed. The Table 4 shows the results thus obtained

The Table 4 shows that all the three domains of the variable of scientific attitude contribute as much as 67.50% of variance towards academic achievement, which may be considered as a high contribution As such, it could be stated that the scientific attitude contributes highly over the academic

TABLE 4

Relative Contribution of Cognitive, Affective and Psychomotor Domains of Scientific Attitude towards Academic Achievement

N	*Multiple R*	*R^2*	*Percentage of Contribution*
120	0 823	0 675	67 50

achievement of the students studying at higher secondary stage. Therefore, the null hypothesis (Ho.4) according to which there is no significant (relative) contribution of cognitive, affective and psychomotor domains of scientific attitude towards academic achievement of higher secondary students, stands rejected

Any percentage of contribution beyond sixty, may not be taken as insignificant one On this ground, the hypothesis has been taken as rejected

Interpretation

The results thus obtained, evidently makes it clear that the two variables under study are related with each other positively, and scientific attitude contributes significantly towards a remarkable and higher portion of academic achievement. Rani (1986) obtained such a variance relatively much lower in case of female science students in relation with their cognitive developmental level, ranging between 30 and 55% only. Baker (1985) found 56 to 67% of variance concerned with attitude to science achievement in middle schools Thus, the results obtained is an expected one and in tune with the fore runners, especially on account of the commonalities between the two variables as stated earlier

Implications

The study implies that on account of high positive correlation between the two variables, it seems to be inevitable to develop better scientific attitude among school going population for their better academic performances This is possible through making science education much more attractive and interesting for them Development of popular science educational packages use of various modes and channels of communication, practising various models of teachings suitable for science teaching in schools, development of integrated science curriculum for general and special learners of significantly higher and lower abilities (general mental ability) etc. seems to be needed for this purpose, so that inculcation of scientific vision and outlook, reasoning and thinking abilities etc could be developed among the students of science beyond secondary level of education

Therefore, it could be mentioned to conclude that all our educational endeavours should be made to inculcate a scientific imagination and outlook among the students at higher secondary level, the basic ingredients in the way to develop proper and positive attitude towards science, so that they must not depend solely upon the rugged traditions, mysticism, supernaturalism and superstitions, but on independent and logical thinking, rational analysis and logical reasoning

Development of scientific thinking ability among each and every future citizen of India is the fundamental duty of all persons who are actively engaged in the field of science education from the very level of primary standards to the higher level institutions, formal or informal

Science, not only cultivates scientific abilities and rationales but at the same time instills scientific temper and humanism, spirit of enquiry, motivation for scientific thinking ability development as well as acting, feeling and be-having in a rational way etc., which are needed to achieve the above target. Therefore, to develop scientific attitude in a proper and desired way among learners and students of science to enhance their achievement significantly, creation of interest and using interesting techniques of science teaching and learning are inevitable if we desire to face the ever increasing and changing problems and challenges ahead during the forthcoming twenty first century

REFERENCES

Allport, G W. (1935) 'Attitude' In Muchison, C(Ed) *Handbook of Social Psychology*, New York

Baker, D R (1985). Predictive Value of Attitude, Cognitive Ability and Personality to Science Achievement in the Middle School, *Journal of Research in Science Teaching*, Vol. 22, No,.2 , pp 103-113

Cheim, I and Evans, M (1948). The Movi Study Games' A Projective Test of International Attitude for Use with Negro and White Children. *American Psychol* , p 268

Doob, L. (1957) The Behaviour of Attitude, *Psychological Review*, Vol. XXX., pp. 135-136.

Golwalkar, S (1978). *A Study of Scientific Attitude of Higher Secondary School Students Offering Different Options*, Unpubl. Dissertn., Psy., Udaipur

Good, C.V. (Ed.1972). *Dictionary of Education*, Mc Graw Hill Book Co , New York.

Jain, S N. (1967) An Investigation for the Construction of Scientific Attitude Scale for Indian Youth, *Project Report*, NCERT, New Delhi

Ram, C. (1986) *Cognitive Development Level and Achievement of Female Science Students*, Unpubl M.Ed. Dissth., Education,. B.H U , Varanasi.

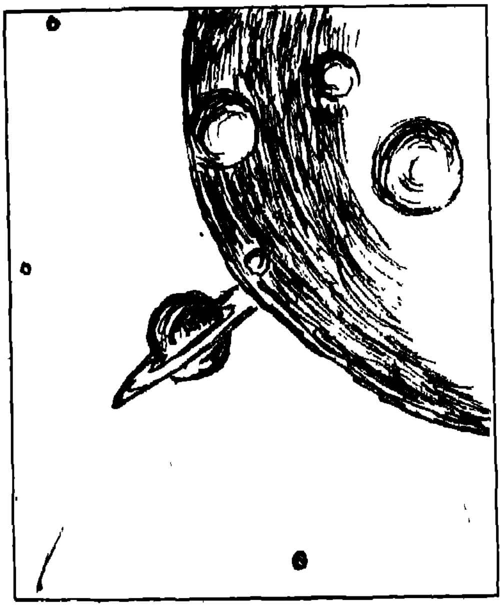
Singh, P N. (1988) *Construction and Standardization of a Test of Scientific Attitude*, Unpubl. Ph D. thesis., Education, B.H U , Varanasi

Thurstone, L L (1929)' Theory of attitude measurements, *Psychol Bull* pp 221-241.

Waddington, C.H. (1948). *Scientific Attitude*, Penguin Books, West Drayton, Middlesex.

Pathfinder – A Historic Mission in Space Exploration – A Report

R. Joshi
Department of Education in Science and Mathematics
National Council of Educational Research and Training
New Delhi 110016



A new landmark in the history of space science was made on Friday, the 4th July, 1997 when the US Spacecraft — *Mars Pathfinder* — made a soft landing on the surface of the red planet Mars For the Americans it was a unique Independence day gift which falls on the fourth day of July The spacecraft was launched in space in December 1996 and took nearly seven months to complete a journey of about 486 million kilometres The *Pathfinder mission* is a part of an ongoing quest for the search of extraterrestrial life besides probing deeper in to the atmospheric and geological conditions of the planet in order to refine present understanding about the origin of planets and the universe. This is for the first time in the last 21 years that a spacecraft from the Earth landed on the planet Mars

The *Mars Pathfinder* project is one of the first Discovery class mission of the National Aeronautical Space Agency (NASA), USA It is the first of the ten planned flights to the Mars over the next decade Another spacecraft, Mars Global Surveyor, is already on its way to orbit the planet in September 1997 These are to be followed by another flights in the years 1998, 2001, 2003 and 2005

The landing of the *Pathfinder* probe on the surface of the Mars has been a spectacular event. The probe comprised a single vehicle with a microrover (Sojourner) carrying with it several instruments to collect data on various aspects of the Martian surface and to transmit the collected information back to the Earth stations. At the time of its touch down on the Mars, the *Pathfinder* was cocooned in airbags with air-cushions all around it As soon as it first touched the surface of the Mars, it bounced wildly for three times to almost 15 metres from the surface before coming to rest on boulder-strewn soil The

Pathfinder's blossom like petals covered with solar cells were exposed to the Sun's rays as its covers got removed automatically on landing. Within ninety minutes radio signals from the *Pathfinder* confirmed its landing on the Mars Soon afterwards, the *Pathfinder* began to transmit 3-D images, with remarkable resolution and clarity, back to the Earth

When the *Pathfinder* began to transmit images of the surface features of the Mars, it became the first spacecraft to do so since 1970s when NASA sent two Viking probes to the planet The main data collector of the *Pathfinder* mission is the microrover or the Sojourner which can move in all directions and over all types of terrain on the surface of the Mars Its motion can be controlled through commands from the Earth station. Sojourner's mobility provides it the capability of "ground truthing" a land area over a few hundred square metres on the Mars. To investigate the surface of the Mars, the *Pathfinder* has been provided with three additional science instruments. These are, the Imager for the *Pathfinder* (IMP) which is a stereoscopic imager with spectral filters on an extendible mast, an Alpha Proton X-Ray Spectrometer (APXS), and an Atmospheric Structure Instrument/Meteorology package (ASI/MET). These instruments will enable the probe to carry out investigations on geology and surface morphology at sub-metre to a hundred metres scale, the geochemistry and petrology of soils and rocks, the magnetic and mechanical properties of the soil as well as the magnetic properties of the dust, a variety of atmospheric investigations and rotational and orbital dynamics of Mars

The data in respect of surface morphology and geology at metre scale is to be provided by the Imager for the *Pathfinder* (IMP). It is envisaged that it will reveal Martian geological processes and surface-atmospheric interactions similar to what was observed at the Viking landing sites Observations of the general landscape, surface slopes and the distribution of rocks are to be obtained by panoramic stereo images at various times of the day Any changes in the scene over the lifetime of the mission might be attributed to the action of the frost, dust or sand deposition, erosion or other surface-atmospheric interactions. A basic understanding of the surface and near surface soil properties is expected to be obtained by the rover and lander imaging of rover wheel track, holes dug by the rover wheels and surface disruptions caused by airbag bounces or retractions

The Alpha-Proton X-Ray Spectrometer (APXS) and the visible to near-infrared spectral filters on the IMP will enable the scientists to identify the dominant elements that make up the rocks and other surface materials on the landing site. A better understanding of these materials will address the questions concerning the composition of the martial crust, as well as secondary weathering products These investigations will also provide a calibration point for the orbital remote sensing observations such as Mars Global Surveyor The IMP is also designed to obtain full multispectral panoramas of the surface and underlying materials exposed by the rover and lander, since the APXS is mounted on the rover Thus, the data received from the Sojourner on this aspect is expected to characterize rocks and soils in the vicinity of the lander.

In order to study the magnetic properties and soil mechanics of the surface, magnetic targets have been distributed at various points around the spacecraft Multispectral images of these targets are to be used to identify the magnetic minerals which make up airborne dust In addition, APXS taking of the materials collected on the magnetic targets will enable the researchers to determine the presence of titanium and iron in the dust. It is expected that it would be possible to infer about the composition of the rocks by using a combination of images, and APXS measurements Detailed examination of the wheel-track images will be utilized to get a better understanding of the mechanics of the soil surrounding the landing site.

The other important objective of the mission is to study the atmospheric structure as well as diurnal and seasonal meteorological variations of the planet The Atmospheric Structure Instrument/Meteorology (ASI/MET) experiment has been designed to determine the temperature and the density of the atmosphere during the Entry, Decent and Landing (EDL). In order to measure atmospheric pressure during this period, the spacecraft has been provided with three-axis accelerometers Soon after landing on the surface of the Mars, the Sojourner began sending meteorological measurements such as pressure, temperature, wind speed and atmospheric opacity. This data is to be collected on a daily basis To facilitate this data collection, necessary devices have been fixed on the Sojourner. For example, thermocouples mounted on a metre high mast will examine temperature profiles with height while the wind direction and wind speed will be measured by the wind sensor mounted on the top of the mast as well as by three wind socks interspersed at different heights on the mast A proper understanding of this data is one of the essential requirements for identifying the forces which act on small particles carried by the wind on the surface of the planet. Regular sky and solar spectral observations using the IMP will monitor windborne particle size, particle shape, distribution with altitude and abundance of water vapour.

A study of rotational and orbital dynamics of Mars is another objective of the *Pathfinder* Mission The *Pathfinder* Lander will utilize its Deep Space Network (DNS), by using two-way X-Band and Doppler tracking, to address a variety of questions related to the orbital and rotational dynamics of the planet. Ranging would involve sending of a ranging code to the lander on the Mars and measuring the time required for the lander to echo the code back to the Earth-based station. Dividing this time by the speed of light would enable the scientists to make an accurate measurement (within 1-5 metres) of the distance between the Earth station and the spacecraft. The basic principle involved is that as the lander moves relative to the earth station, the velocity between the spacecraft and the earth causes a shift in the frequency (doppler shift). Measurement of this frequency shift will provide an accurate measurement of the distance from the earth station to the lander. It is envisaged that within a few months, such observations will provide enough data to determine the location of the *Pathfinder* lander within a few metres. Once the exact location of the lander is identified, calculations to determine the orientation and precession rate (regular motion of the pole with respect to the ecliptic) of the pole would be undertaken and the values so obtained will then be compared with those obtained by the Viking mission about 20 years ago The measurement of the precession rate allows direct calculation for the moment of inertia, which in turn controlled by the density of the Martian rock with depth.

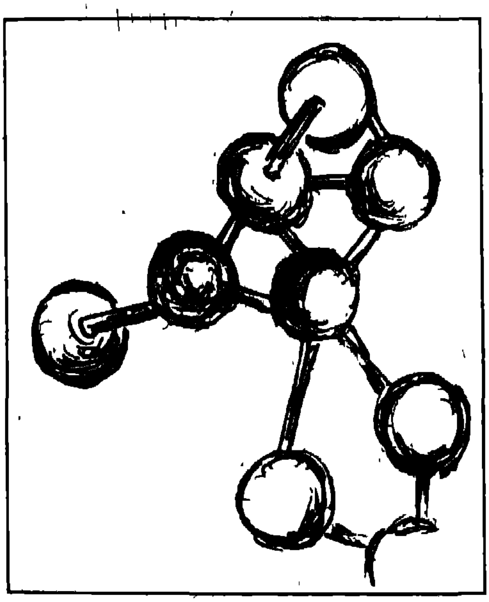
On learning about the landing of the Sojourner on the surface of the Mars, the initial reaction of the people, particularly of the scientific community, all over the world has been euphoric, if not hysteric The red planet has perhaps been the only planet favoured by a host of the science fiction writers and television serial makers who stretched their imagination to create many a mysterious characters besides describing many of its features with such a vivid details that common man had a number of preconceived notions about its mysterious inhabitants and geographical features The photographs transmitted by the *Pathfinder* blew off these myths beyond doubt

For the scientists too, the *Pathfinder* has revealed many new evidences to corroborate or contradict existing knowledge about the surface features and rock formations of the planet. Water is present on the Mars has been debated for many years by the scientists but due to lack of convincing evidences it has remained a mere speculation. The first few images received from the Sojourner has given signs of the existence of ancient water activity on the surface of the planet. Mission scientists while analyzing images, sent from 192 kilometres away, are of the opinion that a light coloured vertical mark on a hill side could be due to an avalanche gully. According to them the horizontal features on another hill could be terraces cut by moving water while horizontal rock layers laid down in a lake or a bathtub ringlike feature left along a shoreline are indicators of water activity. However, these initial interpretations of the images of the planet are tentative and may have to be modified after making further detailed analysis. Another significant discovery made from the analysis of the first few images from the Mars which again is tentative, is the suggestion that the life originated on the planet much before on the Earth. Some of the scientists have gone to the extent of suggesting that the life on the Earth has been transported from the Mars through meteors However, it may still take a few more years to confirm these initial findings beyond doubt.

Unfortunately the Sojourner met with an accident within a week of its landing on the Mars when it got stuck while negotiating over a big boulder. Although scientists at NASA are confident of overcoming this hurdle, it may adversely affect some of the experiments planned through the project. Nevertheless landing of the *Pathfinder* on the Mars has been one of the giant steps in the annals of space science. It will definitely open up new horizons in the field of astronomy and space science

Normality and Molarity in Acid-base and Redox Reactions

Prof. R.D. Shukla
Department of Education in Science and Mathematics
National Council of Educational Research and Training
New Delhi 110016



Today, we try to solve most of our chemical problems on the basis of the *mole* and *molar quantities*. This is in fact more in practice after the *mole concept* was considered to be of fundamental importance. Coming to volumetric analysis in our day-to-day laboratory work, we have started doing work taking 'molarity' as a basis rather than 'normality' in practice so far. Does it mean that we have got rid of 'chemical equivalent' or 'equivalence'? Answer is obviously, 'no' Basic objective of putting 'equivalent' is that *one equivalent mass of a given reactant will react with exactly one equivalent mass of another.* But this 'equivalent mass' is not a fundamental quantity. The idea of 'equivalent mass' can be obtained from molecular mass. Former (equivalent mass) may vary depending upon the reactions whereas molecular mass (molar mass) always remains the same. This is the reason that these days even in volumetric analysis, we have started using molarity instead of normality.

Defining Equivalence and Equivalent Mass

Generally, there are *two types of reactions* for which equivalent masses are defined (i) *neutralization reactions* in case of acids and bases and (ii) *redox reactions.*

The mass of one equivalent of a compound is called its equivalent mass In general,

$$\text{Equivalent mass (Eq)} = \frac{\text{molar mass (m)}}{\text{a}} \quad ..(1)$$

where the value of 'a' depends upon the type of reaction considered How to calculate the value of 'a' is illustrated in the following examples.

(i) *For neutralization reactions:* Equivalent masses are based on the fact that one H^+ (aq) ion reacts with one OH (aq) ion. One equivalent mass of an acid is the amount of the acid that supplies one mole of H^+(aq) ions, and one equivalent mass of a base is the amount of the base that supplies one mole of OH^-(aq) ions. The value of 'a' in equation (1), therefore is *the number of moles of H^+ (aq) ions supplied by one mole of the acid or the number of moles of OH^- (aq) ions supplied by one mole of the base in the reaction under consideration*. For example, 1 mol of H_2SO_4 furnishes 2 mol of H^+ (aq) ions, therefore 'a' will be 2 for H_2SO_4

(ii) *For oxidation-reduction (redox) reactions*· Here, equivalent masses are based on change in oxidation number. In a redox reaction, the increase in oxidation number of one element must equal the decrease in oxidation number of another. An equivalent is defined in terms of change in oxidation number of one unit (unit here means per atom or molecule or ion in redox system), 'a' in equation (1) is the total change in oxidation number (either up or down) that the atoms in a formula unit of the compound undergo in the reaction under consideration. Now let us consider two reactions of $KMnO_4$, (a) oxidation of ferrous sulphate by $KMnO_4$ in acidic medium, and (b) oxidation of ethylene by $KMnO_4$ Reactions can be written as.

(a) $5Fe^{2+} + MnO^-_4 + 8H^+$
$\rightarrow 5Fe^{3+} + Mn^{2+} + 4H_2O$

(b) $3CH_2\text{-}CH_2 + 2KMnO_4 + 4H_2O$
$\rightarrow 3CH_2OHCH_2OH + 2MnO_2 + 2KOH$

The equivalent mass of $KMnO_4$ for a reaction in which the MnO^-_4 ion is reduced to Mn^{2+} ion (where change in oxidation number of Mn is 5), is the formula mass of $KMnO_4$ divided by 5 The equivalent mass of $KMnO_4$ for reaction (b) in which the MnO^-_4 ion is reduced to MnO_2 (where a change in oxidation number of Mn is 3), is equal to formula mass of $KMnO_4$ divided by 3

This aspect can be further highlighted by defining *equivalent mass* in more specific manner. *An equivalent mass of an oxidizing or reducing agent in a redox reaction is the mass of that substance that gains or loses 1 mol of electrons*. This definition ensures that one equivalent mass of an oxidizing agent reacts with exactly one equivalent mass of a reducing agent. As stated earlier, the value of 'a' for an oxidizing agent or for a reducing agent is just the total number of electrons gained or lost by one formula unit of the substance. Now, let us take a specific example of calcium iodate, $Ca(IO_3)_2$ in which IO^-_3 ion is converted into iodide ion, I^- after reduction,

$IO^-_3 \rightarrow I^-$
(5+) (-1)

The oxidation number of iodine in $Ca(IO_3)_2$ or in IO^-_3 ion is +5 and in I^- it is −1. Change in oxidation state per iodine atom is 6. Therefore total change in oxidation state per formula unit of $Ca(IO_3)_2$ is 12 as there are two iodine atoms. It can also be expressed in terms of electrons In reduction of IO^-_3 ion into I^- ion, each iodine changes by $6e^-$ Since in formula unit of $Ca(IO_3)_2$ there are two iodine atoms therefore total number of electrons involved will be 12 Thus, in this reaction, 'a' is equal to 12 Therefore, 1 molar mass of $Ca(IO_3)_2$ is equal to 12 equivalent mass of $Ca(IO_3)_2$. Therefore, the equivalent mass of $Ca(IO_3)_2$ is 1/12 of the mass of a mole of calcium iodate or Equivalent mass

$$\text{of } Ca\,(IO_3)_2 = \frac{\text{mass of 1 mol of } Ca\,(IO_3)_2}{12}$$

This can be further illustrated by taking another example of reaction between iron (II) sulphate and potassium dichromate in acidic medium. The balanced ionic equation of the reaction is written as

$$6Fe^{2+}(aq) + Cr_2O^{2-}_7(aq) + 14H^+ \rightarrow 6Fe^{3+} + 2Cr^{3+} + 7H_2O$$

Now for calculating equivalent mass of $K_2Cr_2O_7$, one has to examine the conversion of $Cr_2O_7^{2-}$ into Cr^{3+} ion i e.

$$\underset{\text{(oxidation state of Cr is +6)}}{Cr_2O_7^{2-}} \rightarrow \underset{\text{(oxidation state of Cr is +3)}}{2Cr^{3+}}$$

Here oxidation state of Cr changes from +6 to +3 i.e a change of 3 But since there are two chromium atoms in chromate ion, total change in oxidation state per formula unit of potassium dichromate is 6 Therefore value of 'a' for the above reaction will be 6.

Therefore, equivalent mass of $K_2Cr_2O_7$

$$= \frac{\text{molar mass of potassium dichromate}}{6}$$

$$= \frac{294 g/mol}{6 Eq/mol} = 49 \text{ g/equivalent}$$

Molarity and Normality and Their Relationship

The molarity, M of a solution is expressed as the number of moles of a solute per litre of a solution. Suppose n mole of solute is present in V litre of a solution, then

$$M = \frac{n \text{ mol}}{V \text{ litre}} = \frac{n}{V} \text{ mol per litre} = \frac{n}{V} \text{molL}^{-1}$$

Similarly, normality, N, of a solution is expressed as number of equivalents of a solute present in one litre of a solution.

$$N = \frac{\text{number of equivalent}}{\text{volume in litre}}$$

Suppose w gram of a solute is present in V litre of a solution, m is molar mass and 'Eq' is equivalent mass, then

$$\text{Molarity, } M = \frac{\text{w gram/(molar mass,m)}}{\text{V litre}}$$

and normality,

$$N = \frac{\text{w gram/(equivalent mass, Eq)}}{\text{V litre}}$$

Further,

$$\frac{N}{M} = \frac{w/Eq}{V} \Big/ \frac{w/m}{V} = \frac{\text{m (molar mass)}}{\text{equivalent mass}}$$

$$= \text{a (using equation 1)}$$

Therefore, $N = a M$ .. (5)

or Normality = a × Molarity

Suppose we consider a substance A The number of equivalents of A, in sample of solution of A, e_A, can be obtained by multiplying the volume of the sample, V_A (in litres) by the normality of the solution, N (which is the number of equivalents of A in one litre of solution)

$e_A = V_A N_A$ (here V_A is in litres)

Similarly, if another substance B is considered, then,

$$e_B = V_B N_B$$

By design, $e_A = e_B$

and therefore, $V_A N_A = V_B N_B$. (6)

Since a volume term appears on both sides of equation (6), therefore, any *volume unit* can be used to express V_A and V_B For example, if we take V_A in mL (millilitre) then V_B also should be in millilitre or if we take V_A in litre (L) then V_B also should be in litre.

Taking help of equation (5), equation (6) can also be written as

$$a_A M_A V_A = a_B M_B V_B$$

or in a more simplified way, we can write,

$$a_1 M_1 V_1 = a_2 M_2 V_2 \qquad ..(7)$$

For further illustrating this, we can select a numerical problem:

What is the molarity of a solution of H_2SO_4 if 50.00 mL of solution requires 37.52 mL of 0.1492M NaOH for complete neutralization.

Now if we apply equation (7)

$$a_1 M_1 V_1 = a_2 M_2 V_2$$

We find a_1 for NaOH will be 1 as 1 mol of NaOH is 1 equivalent, and a_2 for H_2SO_4 will be 2 as 1 mol of H_2SO_4 is 2

Thus a_1	M_1	V_1
1	0.1492M	37.52mL
a_2	M_2	V_2
2	?	50.00mL

Therefore,

$$a_1 M_1 V_1 = a_2 M_2 V_2$$

or $1 \times 0.1492\text{M} \times 37.52\text{mL}$

$$= 2 \times M_2 \times 50.00\text{mL}$$

$$M_2 = \frac{1 \times 0.1492\text{M} \times 37.52\text{mL}}{2 \times 50.00\text{mL}}$$

$$\simeq 0.05596\text{M} = 0.056\text{ M}$$

Thus, taking molarity of the solutions for all our volumetric analysis is more convenient than taking normality. By doing this, students appreciate the basis of normality which is different for different reactions for the same sub-

Science News

Indian Scientists Develop Nuclear Detector

Indian scientists have achieved a major scientific breakthrough in the field of nuclear physics. A team of scientists at the Variable Energy Cyclotron Centre (VECC), Department of Atomic Energy (DAE), Calcutta have successfully developed a "nuclear detector". Many universities and national institutes have collaborated with the VECC in accomplishing this feat through painstaking research and development spread over a number of years. According to the leader of the research team Dr. Vikash Sinha, director of VECC and Saha Institute of Nuclear Physics, the nuclear detector is now at the European Accelerator Laboratory in Geneva

The detector, first of its kind at the Geneva laboratory, is capable of detecting light particles that result from the collision between two atomic nuclei at velocities almost close to the velocity of light. The success has been acclaimed to be ingenious and original by many scientists active in this field. Dr P K Iyengar, former Chairman of the Atomic Energy Commission described it as an excellent example of what Indian scientists can achieve. The project has been adjudged as ingenious, original and at par with the rest of the world by France based physicist Hals Gutbrod

INSAT-2D Satellite Launched

India's fourth commercial and second generation telecom satellite, INSAT-2D, was successfully launched from Kourou in French Guyana on Wednesday, 4 June 1996. According to the scientists at the Indian Space Research Organization (ISRO), the satellite was placed in a near earth orbit soon after its launch in which it takes about ten and half hours to go once around the earth. After a number of successful manoeuvers, the satellite was finally placed in its predetermined parking slot close to its predecessor INSAT-2C after about thirty days of its launch

A number of tests are to be carried out to ensure proper functioning of various components and systems of the satellite before it is put to commercial use. Once the satellite INSAT-2D becomes fully operational it is envisaged that it will usher the country in an era of communication revolution. The satellite has been designed to provide an additional 21 high power transponders and two exclusive facilities to the Indian space segment.

The ISRO is now set to consolidate its experiences and expertise to further boost nation's image as an emerging space super power. It had planned to launch indigenously its first operational remote sensing satellite from Indian soil by the end of 1997. The Polar Satellite Launch Vehicle (PSLV), developed and successfully tested by the ISRO earlier, is scheduled to blast off from the Sriharikota carrying it the remote sensing satellite IRS-1D India has already established its name in the field of remote sensing. The data gathered by its existing remote satellite IRS-1C is being utilized by a number countries including developed ones

The ISRO had also made significant advancement in the development of cryogenic engines to be used in its Geosynchronous Satellite Launch Vehicle (GSLV). According to Dr. K. Kasturirangan, Chairman, ISRO and the Secretary, Department of Space (DoS), the department had an outstanding track record in building 1000 kg remote sensing and 2500 kg multipurpose INSAT class satellites as also rockets that can put IRS class satellites in an earth orbit In the next phase of consolidation of its space programme, ISRO's plans include launching of two more advanced INSAT satellites for remote sensing and communication and to build up commensurate launch capability besides development of the first of the third-generation INSAT-3 spacecraft, and two more remote with sensing satellites. All these satellites, except INSAT-2E, are expected to be launched from India. Once this is accomplished India will no longer be dependent on foreign countries for launch operational facilities for its spacecrafts. INSAT-2E, the last in the series of second generation Indian spacecraft built by ISRO, will be launched from Kourou in 1997-98.

The first of the future remote sensing satellites, IRS-P4-Oceansat is expected to be launched in 1998-99 followed by IRS-P5-Cartosat in 1999-2000 The plans for the development of the next generation INSAT-3 series had been finalized by the ISRO At the same time work has also began on the G-SAT series of satellites to be launched by developmental flights of Geosynchronous Satellite Launch Vehicle (GSLV). The satellites launched through GSLV flights are to be utilized for digital audio-visual broadcasting. This broadcasting system is envisaged to aid long distance education, low cost messaging, tele-medicine and wide band services Boosting of personal mobile satellite communication and navigation systems are also on the agenda of the ISRO's future satellite projects.

Scanners to Identify People by Hands, Eyes or Voice Developed

In modern societies an individual is often asked to establish his or her identity e.g in banks, at the time of migration or voting Signatures, attested photographs, finger prints are some of the modes which are commonly used for this purpose In the recent past the number of situations in which a person is expected to establish his or her identity has gone up many fold The search for a footproof, quick and reliable method of identification has been going for some time. Scientists have now come out with a technique which fulfills this requirement These devices are based on the fact that certain features of every individual are unique to him or her. For instance, the structure of the iris, the patterns on the palm or the finger or certain characters of the voice of a person does not change with age. These "biometry identity" devices maintain a record of the characteristics of individuals in a computer and compare them at the time a person presents himself for identification

The new class of futuristic gadgets will just scan a person's eyes, hands or voice and instantly verify the identity of the person The future automatic teller machines (ATM) in banks are likely to pan a camera across one's eyeball to verify his identity. Similarly, for maintaining the record of the arrival and departure time of workers in an organization, just pressing one's palm on the surface of the device will be sufficient. A voter in future may just have to speak a few words before a microphone to establish his or her identity.

World's Fattest Rats Created

Scientists at the National Institute of Nutrition (NIN), Hyderabad has been successful in developing a colony of rats which perhaps are fattest in the world. Each of these rats weighs on an average 1 4 kg as against the normal 300 gram Biomedical researchers intend to utilise this new strain of over-weight rats as 'models' to develop cures for obesity and diabetes, the two major problems afflicting people all over the world

According to Dr. N V. Giridharan of the NIN's laboratory animals information centre what they have obtained is a pure strain of obese rats having immense potential in facilitating biomedical research The strain of fat rats have been created through selective breeding spread over a couple of years. Breeding the fat rats has not been an easy task for Giridharan and his colleague These were developed from the natural mutants that had evolved through inbreeding of the "wistar" rats maintained by the NIN for the last 75 years. The first step involved was to spot and isolate the mutants and then selectively breed them in large numbers. The present lot of about 400 fat rats maintained at the NIN are in the 11th generation. Breeding fat rats had not been an easy task as the males turned out to be infertile and the females had delayed puberty Only rats which were "carriers" of the genetic mutation had to be mated to establish the colony. Identifying the carriers had been comparatively easy as the rats carrying obesity genes had "kinky" tales. These fat rats has been named *Wnin-ob.*

According to Giridharan, among the fat rats, there is a group of animals which has "impaired glucose tolerance" These will be excellent experimental models to develop drugs for treating diabetes associated with obesity. The next step in this line of research would be to analyse the genetic material of the fat rat to identify and localise the specific genes for obesity and impaired glucose tolerence Scientists believe that identifying and cloning of the specific genes could lead to the development of cure for obesity but it would involve lot of money and time Scientists at the National Institute of Health of the United States of America have shown interest in collaborating with the NIN in this phase of research.

In addition to facilitating research, the fat rats developed by the NIN may also prove to be source of revenue generation for the institute. The fat rats of the NIN are claimed to be genetically purer than the *Zucher* and *Koletsky* rats available for the purpose of medical research. This because these two varieties were developed from "out bred" stocks and therefore are genetically less purer than NIN's strain developed totally from the inbred colony At present, each Zucher rat is sold for a few hundred dollars and the companies which sell them make sure that they are not used for breeding NIN's fat rats may break this monopoly

Gamma Knife Facility Installed at AIIMS

All India Institute of Medical Sciences (AIIMS), New Delhi has acquired a sophisticated Leksell Gamma Knife facility. The facility will be utilised for the treatment of vascular malformations and small tumours of the brain without surgical intervention. At present only two centres have this facility in the south Asian sub-continent, the other being PD Hinduja National Hospital in Mumbai

The gamma knife was developed nearly thirty years ago by the Swedish neurosurgeon Lars Leksell. Since then many improvements and modifications have been carried out in order to further refine it It has been accepted by the medical world as technical aid for about a decade or so

A gamma knife is a device which focusses 201 weak beams, from different directions, precisely to achieve a high level of radiation at the desired point. This destroys the vascular malfunctions or the tumour, thereby ablating it or arresting its growth The procedure involves fixing a stereotactic frame onto the head of the patient and conducting a diagnosis — CT scan or an angiogram The target tumour is identified and localised by reading the coordinates Highly advanced computers are used for devising the treatment plan by calculating the radiation dose and direction. The whole procedure takes a few hours and radiation time just about 20 to 30 minutes Compared to the conventional, invasive, neurosurgery, the treatment with a gamma knife involves a shorter hospital stay and negligible morbidity and mortality

The name gamma knife is somewhat misleading because it is not a knife in conventional sense. It provides an intense and sharply focussed beam of gamma radiations which can destroy (remove) a vascular malformation or a tumour just like a knife. The biggest advantage it provides is the precision and accuracy which are very important in neurosurgery. The gamma knife has fulfilled a long cherished desire of neurosurgeons to acquire a tool that may provide the precision and accuracy required in neurosurgery.

Comet and Asteroid Specialist Shoemaker is Dead

Eugene Shoemaker, co-discoverer of the Shoemaker-levy 9 comet that crashed into Jupiter in 1994 died on July 18, 1997 in a car accident in central Australia He was 69. His wife and long time scientific collaborator, Carolyn was also injured in the accident

Shoemaker did pioneering work on the Barringer Meteor Crater near Winslow in Arizona and proved that it was the result of a strike by a meteor that exploded upon impact He was one of the earliest to propose the idea that asteroid or comet impacts may have caused mass extinction — including the one that wiped out the dinosaurs. He is considered to be the creator of the concept that Earth and the planets are pummeled by asteroids and comets.

In 1973, shoemaker and his wife Carolyn began a survey of asteroids that cross Earth's orbit in order to try to discover the threat they pose to the Earth now. In the process they discovered more than 800 asteroids Their best known discovery, however, was the fragmented comet that plunged into Jupiter which the scientists could watch in nearly real time With the untimely death of Shoemaker, the world has lost one of its pioneering specialist on comets and asteroids

Antibiotics Cut Heart Attack Risk

A team of cardiologists have found that killing off a pneumonia causing bacteium in an infected cardiac patient reduces the risk of a second heart attack The results of a pilot trial carried by the team comprising Dr. Sandeep Gupta and colleagues at St George Hospital Medical School, London has been published in the journal *Circulation* Their findings suggest that antibiotics could become a cheap treatment for some types of heart disease.

The present study has been a sequel to the detection, by researchers last year, of a bacterium called *Chlamydia pneumoniae* in the arterial blockages of 75% of the patients with atherosclerosis or partially clogged arteries Dr Gupta and his colleagues reasoned that if the organism were somehow causing blood clot, then killing *Chlamydia pneumoniae* by antibiotics might cut a patient's heart attack risk

Pursuing their line of argument, Dr Gupta and his team measured the blood levels of antibodies to *Chlamydia pneumoniae* in 213 male patients who had previously suffered a heart attack Eighty of these patients had high antibody levels, presumably indicating a more serious chlamydia infection The researchers treated half of these patients for three days with azithromycin, and antibiotic that wipes out chlamydia infection Eighteen months later, only 8% of the treated men had suffered another heart attack or other serious cardiac event or had died· in contrast, 28% of those who were untreated or given placebos suffered another such consequences Among the 59 men who initially had no chlamydia antibodies, the rate was 7%

These results have been described as provocative by other researchers working in this field. However, they have suggested that a larger study should be undertaken to prove the benefit of treatment and to determine whether it also helps patients who have not already suffered a heart attack.

If azithromycin proves to be a treatment for heart disease, it could be particularly beneficial in developing countries like India where the rate of heart disease is rising very fast and the present mode of treatment involving bypass surgery and balloon angioplasty are beyond the reach of a large number of patients being very expensive Dr. Gupta, however, cautions that the antibiotics might not be effective in all types of heart attacks and therefore the best strategy for preventing heart diseases will still be to avoid the big risk factors — smoking, lack of exercise and improper diet.

Predators Maintain the Balance

The reason behind the same kind of animals appearing in different colours in nature is usually the environment. But it has been found that the red and green alphids live side by side in the same alfalfa fields Why doesn't natural selection weed them out one kind of hues? John Losey, an antmotologist at the University of Wisconsin, Madison, USA and his colleague have found an answer to this question. According to a report published in 'Nature', Losey claims that it is because the two alphids' major predators have different liking for different colours.

In order to find out why both red and green alphids survive, the team of researchers led by Losey looked at how the two enemies of pea alphids — ladybug and wasps — affect the population They sampled 100 alfalfa stems in eight similar locations every day for one whole summer They counted the number of red and green alphids, ladybugs and mummified remains of alphids parasitized by wasp larvae. They discovered that the predators had distinct preferences — ladybugs being partial to red alphids and wasps to the green alphids.

The result is that the two predators keep the colour balanced. With ladybugs eating the red alphids and wasp larvae parasitizing the green, neither form dominates the population and survive. The finding supports the idea of conserving whole ecosystem — including predators — rather than just single species

Alzheimer's Mutations Linked to Cell-death Process

A group of researchers led by Rudolph Tanzi, director Genetics and Aging Unit' at the Massachusetts General (MGH), USA have discovered that two genes associated with early onset Alzheimer's disease are involved in programmed cell death a natural process in which unneeded or worn out cells commit suicide Their study have also shown that an Alzheimer's-causing mutation in one of these genes increases the property of nerve cells to undergo the cell-death process, which is also called apoptosis

Reporting about their work in the journal '*Science*', the researchers have described their studies of the protein products of two genes called presenilins. According to Dr Tanzi the study directly and clearly connects these Alzheimer's genes with apoptosis, which has long been suspected as a mechanism in several neuro-degenerative diseases

As a result of this study, both the types of presenilins now join a select group of proteins which help bring about cell death In the brain, this process usually takes place during early growth, when extra neurons (brain cells) die to assure proper development It has been hypothesized that in older individuals the cell-death pathways becomes reactivated in certain neurons, especially in the regions affected by Alzheimer's. While mutations in these genes appear to speed up this process and cause early-onset Alzheimer's, environmental factors could set off the process in sporadic cases of the disease Thus, the discovery creates an excellent target for new drug development

Presenilin (PS) 1 (which is located in chromosome 14) and PS2 (which is located in chromosome1) were both discovered in 1995 When mutated, PS1 (which is also called S182 and STM-1) is believed to cause roughly 50% of in heritence, early-onset Alzheimer's, while PS2 (also called STM-2) is associated with a much smaller proportion Defects in both genes are directly causative, anyone who inherits a mutated form of the gene is destined to develop the disease, usually before the age of 65.

When apoptosis takes place, many of the proteins that make up a cell are clipped apart by certain enzymes called caspases Although clipping proteins into smaller fragments is a normal part of cellular metabolism, apoptosis-associated clipping takes place at alternative locations along the protein strand, changing the molecular message carried by the protein and eventually leading to the cell's death. The new findings suggest that presenilin proteins are cell-death subtrates — proteins that are clipped by the caspases to carry out the process of cell death.

To confirm the presenilin proteins' cell-death role, the MGH researchers analysed the proteins produced by cultured neurons under normal conditions and after apoptosis was induced by substances that trigger the process They identified the sites at which both presenilins were clipped in normal cellular processing by isolating the two fragments the original proteins were cut into When cells undergo apoptosis, the researchers found, both presenilins are clipped in alternative locations, producing different protein fragments that contribute to the cell-death process

Tanzi believes that the development of the drug that interferes with the caspase-induced alternative clipping of presenilin proteins might delay or prevent the progression of Alzheimer's

Alterations in the Chemical Pathways of Cells Made Possible

It is well known that the bacteria develop resistance to conventional antibiotics after some time The antibiotics, therefore, have to be continuously replaced or modified to be effective on the new resistance variety of bacteria. Scientists have been trying to evolve techniques which may enable them to develop new versions of the old wonder drugs. However, the complex molecular architecture of many of these antibiotics had proved to be extremely difficult parameter to synthesize new versions A group of biochemists in a report published recently in the journal *Science*, have described a way to hijack the antibiotic-producing chemical pathways of the bacteria, and exploit them to produce a wide variety of new compounds.

Bacteria manufacture their cellular products with an assembly line of some 30 enzymes. But in the natural world, that process is limited to molecular building block at hand in the cell The present day chemists are capable of producing far richer array of building blocks than is possible in natural world. So Chaitan Khosla, a chemical engineer at Stanford University, and his colleague decided to give bacteria some new building blocks to work with.

The researchers started with *streptomyces coelicolor*, an organism that is easy to manipulate genetically They had previously engineered the bacterium to express the entire series of enzymes needed to make the common antibiotic erythromycin. Using conventional genetic engineering techniques they disabled the third enzyme in the series, preventing it from stitching together a single six-carbon chain According to Khosla, this is the most crucial step in the entire process.

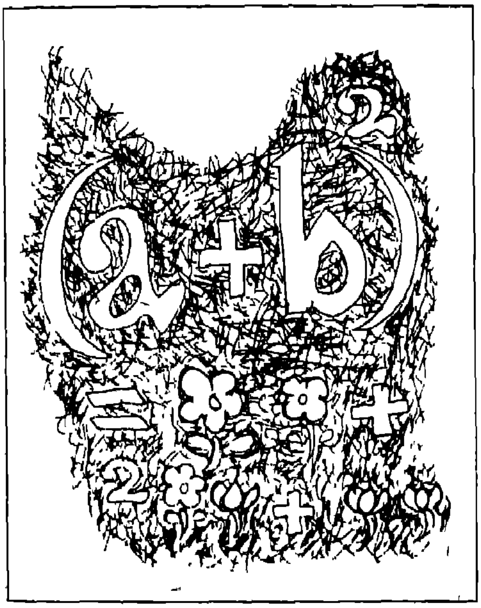
To restart the assembly line, the researchers substituted synthesized molecules slightly different from the six-carbon chain These stand-ins were taken up by a subsequent enzyme and passed along until a final new compound emerged at the end of the assembly line. Khosla asserts that these enzymes seem to be very tolerant to using new substrates which is quite encouraging for making novel natural products. A final processing step at the end to add sugar group converted these products into active antibiotics.

Biochemists are quite optimistic that this research would open the door of making a bunch of new molecules quickly However, they are not equally optimistic that the technique could be scaled up for industrial production because the building block for the analogs must be specifically synthesized, which can be both time consuming and expensive.

Book Review

Fundamentals of Mathematics

By P N Arora published by Sultan Chand and Sons, New Delhi 110002 (10th Edition), pp 1050, Rs.140



The book 'Fundamentals of Mathematics' is written by Dr. P.N. Arora. This huge, magnanimous book is published by Sultan Chand and Sons and costs Rs.140 The author has acknowledged contributions of not less than thirty-two eminent teachers of Mathematics for their contributions towards the book, which shows the amount of efforts made by all of them to prepare a consolidated simple, and complete book for the student to understand the subject and to practice The author rightly believes **"Mathematics without practice is blind, practice without theory is sterile".**

The book is divided into 11 chapters, each chapter is a small book in itself with number of pages ranging from 58 to 146

A large number of questions are taken from DSSE and AISSE and many of them have been solved too Large number of questions on determinants have been solved The question no. 24 on page 1 89 should have been written explicitly as

Show that : $A = \begin{bmatrix} 5 & 3 \\ -1 & -2 \end{bmatrix}$

satisfies the equation

$$A^2 - 3A - 7I = 0$$

and hence find A^{-1}

Elementary row transformation has also been added. Graphs of different functions have been given in detail and explained very thoroughly

Since convergency and divergency of the series is not in the syllabus of +2, it would be better if an alternative method of getting $\frac{d}{dx} x^n$ be given on page 3 10

Most of the chapters are very well written. In the chapter on 'Matrices and Determinants', the author has divided chapters by starting with definition of various types of matrices, then basic operations, etc In 3 D both Cartesian and vector approach have been followed. In Correlation and Regression, the author has given the relation between regression analysis and correlation analysis so that the students may understand the ideas of correlation and regression more clearly. Rank method of finding the correlation is also given which may be useful to the students of other states wherever it is in the syllabus Some misprints are, however, here and there, but I hope these will be removed in the next edition

In all an extensive work has been done in bringing out the book and efforts have been made to present 'one book' which can act as a text reference and practice book for the students The book is also meant for those who are motivated to study mathematics as a specialised discipline at an advanced level and intend to appear for Class XII examination of various Boards' It will help the students who plan to study Engineering and are preparing for various entrance [illegible] The book deserves a pla[illegible] and Senior Secondary School Library and personal book-shelves of students

Dr B Deokinandan
Reader in Mathematics
Department of Education
in Science and Mathematics
NCERT, New Delhi 110 016

SCHOOL SCIENCE

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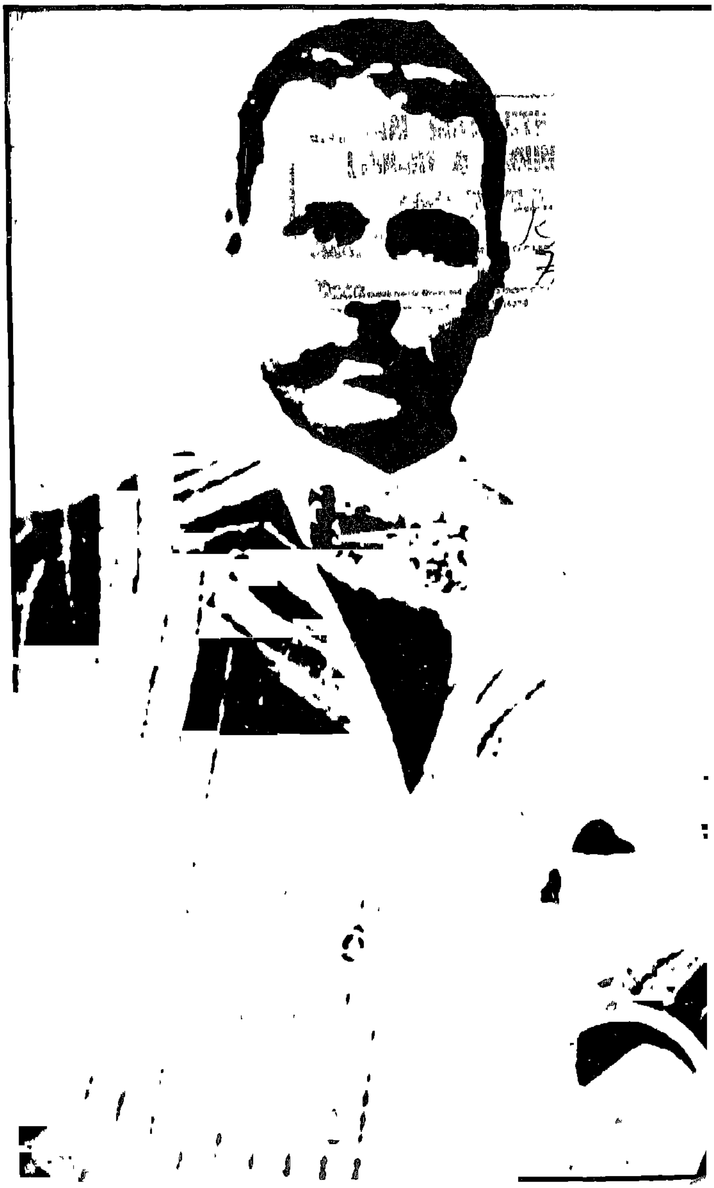

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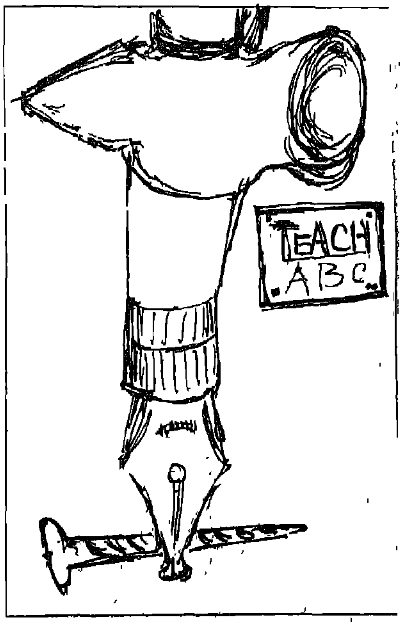

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Fight Against Malaria and Ronald Ross

D Lahiry
A-704 Sarita Vihar
New Delhi 110044

Malaria has been one of the biggest killer diseases in the history of humanity Not cholera or plague, nor to speak of AIDS. It is estimated that during the Second World War, more American soldiers in the far east died of malaria than that killed by the human enemy It still remains the number one public health problem in many countries More than one million people die in Africa. In India alone 20 to 30 million people suffer from malaria every year In spite of continuous advances in malariology, and advances in public health services, it is still causing havoc taking heavy toll of life and inflicting severe damage to the health of the people Malaria is one of the most important causes of economic misfortune, engendering poverty, diminishing the quality of food supply, lowering the physical and intellectual standard of the nation It also harms economic progress in every way

Human fight against malaria is a unique story This is a long story spreading over two thousand years with many ups and downs It is an example of how finding solutions to a long standing problem of such a magnitude requires combined efforts of every branch of science—medicine, biology and chemistry as well as organised health services, social action groups, and above all strong political will. Whenever a favourable combination could be achieved, the control of the disease seemed at sight And in fact, it has been eradicated from a large part of the globe Slackness in any one respect or more has caused reversal of greater magnitude. In this article, however, we shall restrict ourselves mainly to the bioscientific aspects of the story depicting the nature of science and history of ideas It might also illustrate how the knowledge of one period becomes a myth later in history and how science progresses gradually

Till less than a century ago occurrence of malaria was spread over all continents In the old world it has been a menace in the south and southeast Asia, Japan, northern Australia, southern Russia, Great Britain, continental Europe and almost all inhabital areas of Africa In the western hemisphere malaria was preponderant from central South America to the southern fringes of Canada Today whole of North America, Europe and a large part of South America are almost free of malaria. All ancient civilizations namely that of China, Egypt, Greece, India, Iraq and Italy were plagued by Malaria It is said that Alexander the Great of Macedonia died of the disease Some believe that decline of Greek and Roman civilizations was partly caused by malaria

Symptoms of Malaria

Usually malaria is characterized by a high fever with feelings of cold, headache, muscle-ache, dry mouth and rough skin. After a few hours the patient feels warm and has nausea, followed by sweating and remission of fever. If untreated this sequence recurs every 48 hours (72-96 hours in some cases) for several weeks Thereafter the patient may be relieved for a few months or even a year He often gets similar attacks repeatedly resulting in anaemia, enlargement of spleen, physical emaciation and lastly death In one type of malaria, one or a few spells of high fever may lead to rapid deterioration and sudden death if suitable treatment is not given in time

A Long Search for the Cause

As mentioned earlier, all the ancient civilizations were serious victims of malaria. Even two thousand years ago some of the physicians had preliminary ideas about the disease They could recognise malaria by its symptoms and called it 'intermittent fever' as distinct from 'continuous fever'. Some of them could even distinguish between different types of malaria also It was widely noted that the disease preponderates in marshy areas, near swamps and was more frequent among people who slept outdoors They thought that it was caused by breathing foul air poisoned by the stagnant water The disease also acquired its name from the same belief (Italian mal-bad, aria-air) It may seem to be silly today but even this belief helped to control the disease to some extent

Since the disease was associated with stagnant water, the Romans tried to control the disease by flushing swamps and marshes Roman officers posted in certain areas of the empire observed that the places having large population of buffaloes who frequently visited swamps were comparatively free from malaria. They imported buffaloes from Egypt to southern Italy where the disease was rampant This measure also gave some respite. Can you imagine why?

After the decline of the Romans, the West entered the dark age. No significant progress in respect of malaria could be made in the next thousand years or more, till the late renaissance period However, it has recently come to light that in the sixth century a Chinese philosopher accidentally discovered a 'warm wood' tree (*Artemisia enua*, Chinese name Kunghow tsud) the bark of which was effective for the treatment and prevention of malaria.

After the advent of renaissance a new awakening swept through Europe. Old ideas and authorities were begun to be challenged New ideas based on explorations, experiments, and observations poured in Ideas about land and oceans expanded The new world (western hemisphere) was discovered. The Europeans started getting hitherto unknown samples of plants and animals as well as experiences and ideas extant in distant lands

In the seventeenth century a large variety of substances derived from plants, animals and minerals were tried to cure different diseases including malaria Most of them were of no value; some of them were even harmful Among those some were products sent from abroad One of these products was the bark of a Peruvian tree (native name quina quina) which the local people used as a medicine for fever This was thought to be a good benign cure of malaria in Europe and became very popular. The demand for the bark of the tree rose so high that soon it became difficult to arrange for its transport The supply source also tended to become exhausted. Some dishonest merchants began to substitute it by a similar looking bark of another tree Strangely, this attempt of gross adulteration became an unexpected benefit It was found out that quina quina was not as effective as the new adulterant was. The new tree yielding the effective medicine for malaria was named Cinchona after the name of the wife of the then Portuguese governor. Later the active fraction extracted from Cinchona bark called quinine remained the only potent cure till mid twentieth century Is it not strange that a drug that served humankind for three centuries was discovered accidentally that too from an adulterant

The Parasite Discovered

After a satisfactory treatment was found, physicians tried to verify the cause of malaria Some of them volunteered to drink water of the swamps that were said to be the cause of fouled air Some deliberately breathed the air around the marshes. No one got malaria The age old ideas began to change Several speculations were floated Some scientists dissected and examined the body parts of the dead patients, others examined the blood of suffering patients A few held the newly discovered bacteria as the causative agent But no satisfactory solution could be found for a long time

Malarial parasites were apparently first seen by Meckel in 1847 Several others also reported some stages in the blood of human being. Significance of their discovery was not recognised until Laveran's somewhat explicit studies were published in 1880 who was able to see them in the blood corpuscles of malarial patients Subsequently the scientists reported different stages of the parasite in and out of the RBC By then it was known that malaria is also common in many birds and apes In 1885 Marchiava and Celli produced cases of malaria by inoculating human volunteers with blood containing the parasites Gradually it was accepted that malaria is caused by a protozoan parasite belonging to the genus *Plasmodium*. It was also found that there are four species of the genus namely (i) *P. vivax*,

(ii) *P. falciparum*, (iii) *P. Malariae* and (iv) *P. avale* which are responsible for different kinds of malaria

P. vivax causes benign, tertian (fever every alternate day) malaria, resulting in slow degeneration of the patient engendered by destruction of the RBC. The benign nature of this type of malaria often tempts patients to neglect its treatment This attitude has aggravated its effect on the population. *P falciparum* is responsible for malignant, tertian malaria (also called cerebral.malaria) It is the most dangerous form of malaria It affects the brain leading to fast deterioration of the patient and sudden death if proper treatment is not given in time. *P malariae* causes benign, quartant (fever every 72-96 hours) malaria which is not so much dangerous *P. ovale* is responsible for tertian malaria which is even milder.

The relative incidence of these parasites and hence the occurrence of different malarias varies in different parts of world. Some differences are also observed in the same area observed in the same area from year to year. *P. vivax* is of widest distribution (about 65% - 69%0 *P faliciparum*, the killer malaria comes second (25%-30%) *P. malariae* has a restricted distribution (1%-3%) and *P. ovale* is a rare parasite in man.

Carrier Identified

Once it was known that malarial parasites are causative agent of the disease and a person gets malaria if he receives blood of another person containing the parasite, scientists wondered who injects the parasites in the normal cases Since malaria is associated with stagnant water which was the home of many insects including mosquitoes, the latter became the main suspects. As early as in 1717, Lancisi stated that marshes cause malaria through the transformation of minute worms into mosquitoes which infused a poisoned liquid into the wounds they inflict What did he observe in the marshes? Must be mosquito larvae, what else? In 1883 Kreig and King produced circumstantial evidences to pinpoint the mosquito as an agent of transmission of malaria. Laveran, Manson, Pfeifler and many others were of the same opinion But experimental proof was eluding them. It was Ronald Ross who first took up experimental investigation into the role of mosquitoes

As the first step Ross experimentally verified that it is the Anopheles mosquito and not the other species that suck in the malarial parasites from in-

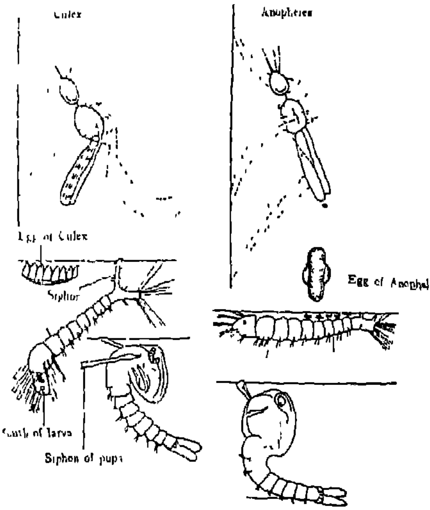

Fig. 1 Life history of the mosquito (Anophles and Culex) Note the differences in the sitting postures of their adults, shape of egg and position of larva.

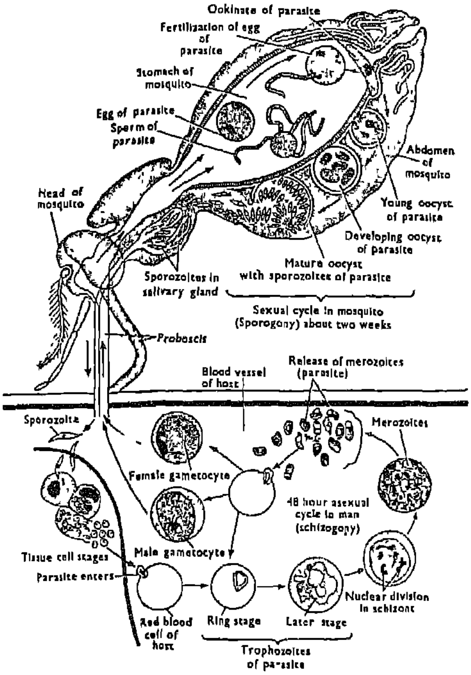

Fig. 2 Life history of malarial parasite *Plasmodium*, showing different stages in mosquito and human body

fected patients along with his blood He also showed that these parasites multiply in the stomach wall of the mosquito establishing thereby that the Anopheles mosquito was the natural host of these parasites (1897) It was a very significant contribution. Then he went on to demonstrate that' malarial parasites are injected into another victim during a mosquito bite But without human volunteers he had to work with bird malaria (*Proteosoma sp*) in sparrows He discovered sporozoite stage of malaria in the salivary glands of the mosquito (1898). So, the human mosquito-malaria enigma was solved.

Immediately after, Grassi (1898-99) found similar cycles in *P falciparum*, *P vivax* and *P. malariae* He also unequivocally demonstrated that mosquitoes act as vectors and transfer malaria in man Ross's work, therefore, cleared several mysteries of the past, opened the door for many future discoveries and paved the way for launching antimalarial campaigns on a global scale.

Ronald Ross

Sir Ronald Ross was awarded the Nobel Prize in 1902 'for his work on malaria by which he has shown how it enters the organism and thereby laid the foundation for successful research on this disease and how to combat it'. He was the second Nobel Laureate in medicine and physiology since its inception.

He was born at Almora in the Kumaon hills of Uttar Pradesh on 13 May 1857. He came of a three generation Anglo-Indian family and was the eldest son of a General in the Indian Army. He had his medical education in England. After obtaining the MRCP Diploma in 1879, he worked as a surgeon of a ship for some time and then entered the Madras Medical Service. During his home leave in 1888, he studied bacteriology and got DPH Diploma. He also got some familiarity with the mosquitoes. He returned to India in 1892 and began to take special interest in malarial parasites. He took the opportunity of observing and studying the parasites under the guidance of Patric Manson during his second leave in 1884. Coming back to India next year he devoted himself to experimental investigations of the mode of transmission of malaria. He remained in touch with Manson who always encouraged him. But his research was con-

stantly being hampered by frequent transfers at its crucial stages. In spite of the impediments he continued resolutely and got the breakthrough in 1897 and 1898. Thereafter he was sent to Assam to investigate the large scale occurrence of black fever (kala azar). The same year he took retirement from the Indian Medical Service and migrated to England. He joined the Liverpool School as a lecturer where he became a Professor in 1902. In 1912 he joined the King's College Hospital, London as a physician for tropical diseases. During the First World War (1914-18) he worked as consultant in various organizations to advise on antimalarial campaigns.

Apart from scientific papers and his Memoirs, he wrote several books on poems and romances. Ross was honoured with investiture of Knight Commander of the Order of the Bath in 1911 and in 1918 he became Knight Commander of the Order of Saint Michael and Saint George. Later, in 1926 the Ross Institute and Hospital for Tropical Diseases was established in his honour at Putney. He breathed his last at Putney in 1932.

Can you now understand why draining of marshes and introduction of buffaloes had helped Romans in reducing malarial cases locally. Obviously these steps caused disturbance to the breeding grounds of mosquitoes

Eluding Control

Once the vicious cycle of man-mosquito-malaria was known it became clear that eradication of malaria can be attempted in two ways. (i) curing malaria patients by effective drugs thereby reducing the source of the parasite, and (ii) destroying the mosquitoes mainly by controlling their breeding and development so that the transmission of malaria was interrupted.

By mid twentieth century preparation for malaria eradication was complete Effective drugs (quinine, chloroquine, antibiotics) for cure of malaria became easily available At the same time powerful insecticides (DDT, BHC etc) and mosquito repellents for suppressing mosquito menace were also on the racks Adoption of the two-pronged attack went very well by early sixties of the twentieth century The disease was totally suppressed in several countries and quite tamed in many others including India. The death per year came down from three million in 1946 to two million in 1961 The total number of incidence also sharply declined It was hoped that the disease would totally controlled within two decades However, only those countries whether developed or developing succeeded in their efforts which never loosened their grip on the eradication campaign. A sense of complacence crept in at this crucial junction of the campaign both at the global effort as also at the country level campaigning The attention was diverted to the wars in the Southeast Asia, flow of money tapered off and the operation plans had to be down sized Medical attention both for research and training shifted to more challenging areas, malaria eradication programmes of the Public Health Services became tardy This was followed by injudicious use of drugs often faulty treatment schedule as well as indiscriminate use of insecticides The consequence was disastrous New strains of drugs resistant parasites and insecticide resistant malarial mosquitoes

Description of the Prize Winning Work*

"Towards the middle of August (1897) I had exhaustively searched numerous grey mosquitoes and a few brindled mosquitoes. (Unable to obtain literature on mosquitoes, Ross made a working classification of his own and invented simple names His grey mosquitoes belonged to the genus Culex, his brindled mosquitoes to the genus Stegomyia) The results were absolutely negative, the insects contained nothing whatever

"I had remembered the small dappled winged mosquitoes (genus Anopheles), but as I could not succeed either in finding their larvae or in inducing the adult insects to bite patients, I could make no experiments with them On the 15th August, however, one of my assistants brought me a bottle of larvae, many of which hatched out next day Among them I found several dappled-winged mosquitoes, evidently of the same genus as those found about the barracks, but much larger and stronger. Delighted with this capture I fed them (and they proved to be very voracious) on a case with crescents in the blood. Expecting to find more in the breeding bottle and wishing to watch the escape of the motile filaments in this new variety, I dissected four of them for this purpose immediately after feeding This proved to be most unfortunate, as there were no more of these insects in the bottle, and the results as regards the motile filaments were negative I had, however, four of the gorged dappled-winged mosquitoes left, but by bad luck two of the dissections were very imperfect and I found nothing. On the 20th August I had two remaining insects both living Both had been fed on the 16th instant I had much work to do with other mosquitoes, and was not able to attend to these until late in the afternoon when my sight had become very fatigued The seventh dappled-winged mosquito was then successfully dissected Every cell was searched, and to my intense disappointment nothing whatever was found, until I came to the insect's stomach There, however, just as I was about to abandon the examination, I saw a very delicate circular cell apparently lying among the ordinary cells of the organ, and scarcely distinguishable from them. Almost instinctively I felt that here was something new. On looking further, another and another similar object presented itself I now focussed the lens carefully on one of these, and found that it contained a few minute granules of some black substance exactly like the pigment of the parasite of malaria I counted altogether twelve of these cells in the insect, but was so tired with work and had been so often disappointed before that I did not at the moment recognize the value of the observation. After mounting the preparation I went home and slept for nearly an hour On waking, my first thought was that the problem was solved; and so it was

"Next morning the eighth and last dappled-winged mosquito . was killed and dissected with much anxiety. Similar bodies were present in it .. The objects lay, not in the stomach cavity of the insects, but in the thickness of the stomach wall ..

"These two observations solved the malaria problem They did not complete the story, certainly, but they furnished the clue. At a stroke they gave both of the unknown quantities — the kind of mosquito implicated and the position and appearance of the parasites within it."

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* From Ronald Ross, "Researches on Malaria," *Les Prix Nobel en 1902*

emerged to make the task of cure and control more difficult. The worst was the development of drug resistant types of malignant or cerebral malaria (*P. falciparum*) and their rapid invasion in different parts of the world including India.

However, experts say that the war against malaria is not lost as yet The man-malaria fight can still be tilted in favour of human if we renew the campaign with all the vigour and resources at our command correcting our past mistakes Even with the arsenal of existing drugs and the available insecticides the campaign can achieve success. In this centenary year of Ross's great discovery and fiftieth year of India's independence, we could make us proud by taking a sincere pledge to eradicate the curse of malaria from our country

REFERENCES

BOYD, M.F., 1940 Edited, Malariology; A comprehensive survey of all aspects of this group of diseases from a global standpoint, W B Saunders, Philadelphia

BSCS, 1963. Biological Science: An Enquiry into Life, Harcourt, Brace & World Inc. New York, Chicago, Atlanta, Dallas and Burlingame

HALL, R P., 1961, Protozoology, Prentice Hall, Inc New Jersey, Charles, E. Tuttle, Tokyo,

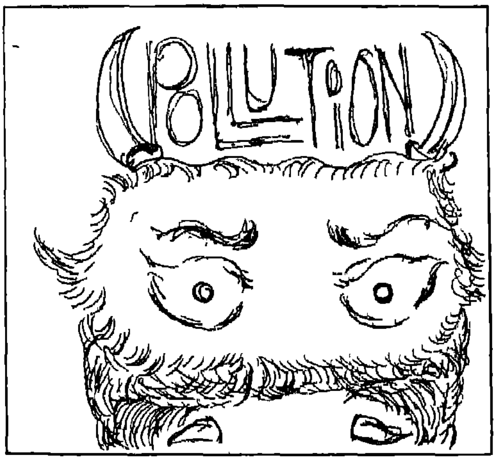
STEVENSON, L G., 1967. Nobel Prize winners in medicine and physiology, 1901-1965, Abelard-Schuman, London, New York, Toronto

WHO, 1984. Malarial Control as a part of primary health care, Report of the WHO Study Group, Technical Report Series 712, WHO, Geneva

How can Heavy Metal Pollution Be Removed?

PROFESSOR M. CHANDRA
Department of Education in Science and Mathematics
National Council of Educational Research and Training
New Delhi 110016

In the two previous issues of the Journal we have discussed the meaning of the term heavy metal pollution in general and the nature of pollution due to cadmium, mercury, lead and arsenic in particular



The term 'heavy metal', as explained in some details in the June' 97 issue of this Journal is somewhat imprecise. The term includes most metals and metalloids with atomic number greater than 20, but excludes alkali metals, the alkaline earth metals, the lanthanides and the actinides The term is commonly adopted as a group name for the metals (and metalloids) which are associated with pollution and toxicity, although heavy metals also include elements such as iron, copper, manganese, selenium, and zinc, which at low concentrations are essential for living organisms 'Toxic metals' or 'trace metals' are two other terms suggested as alternatives to the term heavy metals but these terms are yet to attain common usage Thus we have used here the more widely recognised term, 'heavy metal' (in elemental or combined form, irrespective of whether the element is a metal or metalloid)

Heavy metals are continually released to the environment by natural processes, such as geological activities, volcanic eruptions, weathering of rocks and soils for millenia, living beings have collectively and individually managed to cope with this natural discharge of heavy metals to their environment Environmental pollution caused by the addition of heavy metals to the ecosystem due to anthropogenic causes (i e caused by human activities) began with the domestication of fire itself But the 'Industrial Revolution' with its unprecedented demand for metals, and factors such as greater urbanisation, increase in vehicular traffic and use of modern agricultural practices have ultimately started interfering with the nature's own processes. Heavy metals as pollutants of the ecosystem have however received increasing attention only in the recent years, partly because of the growing scientific and public awareness of the environmental issues.

From the point of view of environmental degradation, of all the heavy metals, cadmium, lead, mercury and arsenic have been the source of major concern to living beings.

In the preceding two parts of this article (published in the last two issues of this Journal) we have discussed the toxicity of the heavy metals, in general, and the environmental problems due to cadmium, mercury, lead and arsenic, in particular In this article, we conclude our discussions on heavy metal pollution by discussing some of the methods used to remove heavy metal pollution for the environment.

How Can Heavy Metal Pollution Be Removed?

The removal of heavy metals under variable field conditions is a very difficult task In most cases, heavy metals are either present in highly diluted states in the range of a few ppm in large volumes, or in the range of several thousand ppm, but in limited volumes. The approach for their removal, therefore varies with their concentration, volume and other specific factors. Although some methods exist and some are under development for minimising the amount of toxic metals released from current industrial processes, the remediation of existing toxic sites remains a pressing problem. There are two basic ways to approach the removal of heavy metals. One method is to design systems for a single metal- and the other is to employ one specific process, that could be used for several different metals. However, it would be over ambitious to consider that one process would have such a broad application as to remove a variety of heavy metal ions

Many rivers and sediments are highly contaminated by heavy metals and such sediments act as source to recontaminate the water that flows above them Several types of remediation methods have been used for such contaminated sediments. The simplest of these is often to just cover the contaminated sediments with clean soil (or sediment), thereby placing a barrier between the contaminants and the water Cadmium is often the heavy metal of concern in such sediments If the pH of the resulting soil is 6.5 or higher, most of the cadmium does not dissolve, resulting in a concentration which is tolerated. Several chemical and biological methods of decontaminating sediments are also in use Treatment with calcium carbonate or lime for example, increases the pH of the sediment and thereby immobilises the heavy metal In some situations, contaminated sediments are simply covered with chemically active solids, such as limestone, gypsum, iron (III) sulphate or activated carbon, that gradually detoxify the sediments. For such purposes, the sediments are often first dredged from the bottom of the water body and then treated Heavy metals are also removed at times by acidifying the sediments and treating them with chelating agents, such that the heavy metals become water soluble and leach from the soil The cleared sediments can be returned to the water body or spread on land (1)

The adsorption of Cd (II) ions from aqueous solution on materials such as activated charcoal, discarded rubber tyre, fly ash and bituminous coal have been studied Sawdust has also been found to be a cost effective adsorbent However, these processes are highly pH dependent (Table1) (2)

Table 1

pH Range for Qualitative Precipitation of Cadmium, Lead, Mercury*

Metal	*pH range*
Cadmium (soluble in presence of ammonium salt)	6 8—12
Lead	6 0—9 0
Mercury	7 5—12

*Source Porteous (A) et al Hazardous Waste Management Handbook, Butterworth p 157

Agricultural waste, viz rice husk has also been found to be effective for the removal of cadmium from industrial wastes. The silica in the rice husk is responsible for the adsorption (3). Biological removal of toxic metals from sewage effluent — a more recent method, has also been used effectively for removal of cadmium. The metal cation in this case, is found to simply bind to the negatively charged groups of these biological cell surfaces On altering the conditions, the metal is released and the organism is recharged (4)

Elemental mercury is extremely volatile, travels hundreds of kilometres and contributes to the atmosphere load It is insoluble and once out of the stack of the industrial units is not captured easily Mercury has been found to be removed to some extent by activated charcoal and by selective solvents. These methods are being tested at present in pilot scale in coal fired power stations Any oxidised mercury escaping from stacks in industrial units is deposited in a local or regional scale. Activated carbon has been observed to have the potential to control such oxidised mercury Recently aquatic plants have drawn much attention of workers as an effective tool for the removal of heavy metals from water bodies For example, 'Pistia' and 'Hydrilla' have been used for removal of Hg (II) These plant species have at times been considered as Hg (II) accumulators as well (5)

In the removal of lead, one of the more traditional methods has been the use of coal fly ash, since it has a good adsorption capacity for Lead (6) Of course, the catalytic convertors fitted to cars and the use of unleaded petrol should help reduce lead emission to the atmosphere considerably.

One of the efficient methods of removing arsenic is to treat water affected by arsenic with sodium sulphide, in presence of ferrous sulphate* and then acidify this with dilute sulphuric acid to optimise the pH The precipitation of arsenic as sulphide is total and complete. With the addition of coagulating aids, the precipitate is made easily filterable The control of pH in this method is important, since the solubility of arsenic sulphide in alkaline medium makes the method less attractive (7). One of the effective methods of removing arsenic has also been to oxidise the As (III) to As (V), followed by addition of excess of iron (III) salt to coprecipite Arsenic with hydrated iron (III) made in alkaline medium (8).

Biological Processes

For the removal of heavy metal ions,

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* as coagulating agent

biological dimensions have been added recently, to the general chemical processes already in use for the purpose. These methods are specially useful, when very low concentration of the heavy metal makes recovery by traditional physiochemical methods unprofitable Table 2 shows some of the biological processes that are currently in use, or are being tested for the removal of heavy metals from the environment

Bioremediation, i e the biological removal of heavy metals is an attractive and cheap alternative to the conventional chemical clean-up methods (9). Cadmium for example, at low concentrations, is used by microorganisms as micronutrients—the toxic effects are observed at higher concentration. Bacterial activity oxidises As (III) to As (V) and subsequent methylation reduces toxicity. Biological treatments are natural systems, which rely on the naturally occurring micro-organisms, such as bacteria and fungi, in order to convert the toxic heavy metal pollutants to non-toxic or less toxic substances (10). In future, it seems a very large number of heavy metal contaminants are likely to be treated by such bioremediation methods.

Concluding Remarks

The fear of various pollutants spewed out by the different countries changing the genetic make up of animals and plants is not far fetched any longer. Indeed the possibility is so real to some ecologists, population specialists and toxicologists that they have created the new discipline of 'Evolutionary Toxicology' Many modern chemicals, including heavy metals, that pour into our rivers and streams or beltch into the air, are thought to be actually capable of

TABLE 2

Types and Characteristics of Biosystems in Treating Mercury, Lead, Cadmium, Arsenic

System	*Characteristics*	*Metal*
Biocolloid formation	Employs bacteria to transform toxic metal ions to less toxic forms with concomitant colloid formation An aerobic process requiring bacteria with active metabolism	Lead
Sorption	A passive system, where water containing toxic metal is passed through a bed of encapsulated bacteria or algae.	Cadmium Lead, Mercury
Volatalisation	Bacteria and fungi readily methylate toxic elements thereby accounting for transfer of toxic metal from a terrestrial environment to the atmosphere	Mercury Arsenic
Wetlands	Natural or artificial shallow ponds that contain plants, algae, fungi and bacteria	Lead

Source: WISE (D L). and TRANTOLO (D J.) (ed). Remediation of hazardous waste contaminated soils. Marcell Dekker Inc (1994), 929 pp.

triggering mutations in fauna and flora World over countries have become concerned about pollution in general, and pollution due to heavy metals in particular India is no exception in this respect As a response to the general problem concerning the environment and its protection, the Government of India has set up in January 1985, a separate ministry — the Ministry of Environment and Forests, with a department specifically to look into issues concerning the Environment On 26 February 1992, the Ministry came up with the important policy statement "Policy statement for Abatement of Pollution" This 'statement' expresses a commitment of the Government of India on abatement of pollution for preventing the deterioration of the environment. For effective enforcement of the 'Policy' the individual State Governments have also formulated a number of rules for the guidance of the enforcement agencies Quite a few NGOs(non-governmental organisations) are active in this field. With the passage of time, the general public has also gradually become concerned about environmental issues

REFERENCES

1 Sen, A K. and Mondal, N G. Salvania Natanai as a Scavenger for Cr (III), in Sen, A K (ed) Environmental Management and Planning Wiley Eastern Ltd (1988), 304 PP

2. Raji, C and Anirudh, T S. Managing Aqueous Solutions Rich in Cd (II)' An Inexpensive Technique Ind Jn of Env Protection. 16 (1986) 406-412

3 De, A K , Sen, A K., Karim, M R Removal of Zinc and Cadmium from Waste Water by Rice Husk, in Sen, A K (ed) Environmental Management and Planning Wiley Eastern Ltd., (1988) 304 pp

4 Sidwick, J.M and Holdom, R.S. (ed). Biotechnology of Waste Treatment and Exploitation Ellis Horrwood Ltd., (1987). 332 pp

5 Sen, A K and Mondal, N G Salvania Natanai as a Scavenger for Cr (III), in Sen, A K (Ed) Environmental Management and Planning, Wiley Eastern Ltd (1988) 304 pp

6 Sen, A.K and De, A Removal of Pb (II) and Mercury Using Fly Ash in Sen, A.K (ed) Environmental Management and Planning Wiley Eastern Ltd , (1988) 304 pp

7 Chatterjea, T P Some New Techniques of Removal of Heavy Metals in Sen, A K (ed) Environmental Management and Planning. Wiley Eastern Ltd , (1988). 304 pp

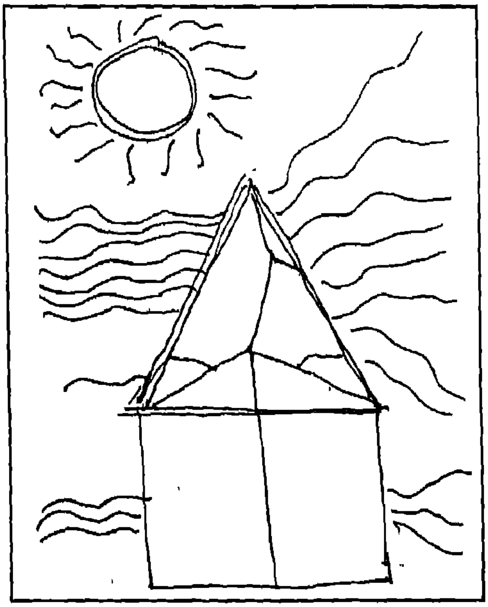
8 Porteous, A et al Hazardous Waste Management Handbook Butterworth, 306 pp

9 Goudar, C.T. and Subramanian, P. Bioremediation of Hazardous Waste Management Ind. Jn. of Environmental Protection, 16 (1996) 124 128

10 Bandopadhyay, S , Bhatia, S K and Majumdar, P Aspects of Bioremediation, in Wise, D E. and Trantolo, D J (ed) Remediation of Hazardous Waste Contaminated Soils Marcel Dekker Inc (1994) 929 pp

Alternative Derivations for the Angle of Minimum Deviation by a Ray Passing Through a Prism

S.N. Maitra
Mathematics Department
National Defence Academy
Khadakwasla, Pune 411023

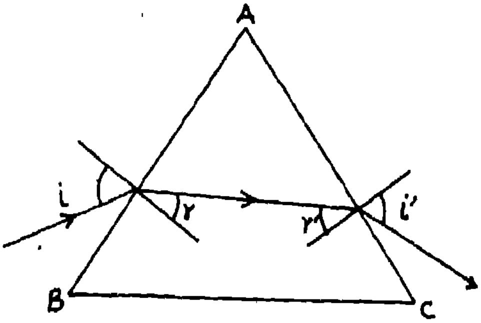


In the textbooks of Optics, the expression for the minimum deviation of a ray passing through a prism is obtained with or without the use of calculus. In this article, two different methods, one using calculus and the other without the use of calculus, for determining the angle of minimum deviation for the ray passing through a prism have been suggested These methods are usually not found in the present day textbooks

Method I

Consider a ray of light incident on one face of a prism, of refractive index μ, at an angle i. Suppose this ray of light after getting refracted at an angle r strikes the other face at an angle r' and then emerges out at an angle i' as shown in the Figure From Snell's law we get

$$\frac{\sin i}{\sin r} = \frac{\sin i'}{\sin r'} = \mu \qquad (1)$$



By geometry of the prism as shown in the Figure, the deviation of the ray is

$$D = \theta - A \qquad (2)$$

where A is the refractive angle of the prism and

$$\theta = i + i' \qquad (3)$$

$A = r + r'$ (is a constant for a given prism)

By using equation (1) along with trigonometric formulae and relationship (3), one gets

$$\begin{aligned}\mu \sin r' &= \sin(\theta - i)\\ &= \sin\theta \cos i - \cos\theta \sin i\\ &= \sin\theta\sqrt{(1-\mu^2 \sin^2 r)} - \mu \cos\theta \sin r\end{aligned}$$

which on simplification gives

$$\mu(\sin r' + \cos\theta \sin r) = \sin\theta\sqrt{(1-\mu^2 \sin^2 r)}$$

On squaring and simplifying, we get

$$\sin^2\theta = \mu^2(\sin^2 r + \sin^2 r' + 2 \sin r' \sin r' \cos\theta) \quad . (4)$$

Noting that A = r + r′ and, therefore, A − 2r = r′ − r, and using trigonometrical relations, equation (4) can be simplified as

$$\sin^2\theta = \mu^2[1 - \cos A \cos(A - 2r) + \{\cos(A - 2r) - \cos A\}\cos\theta]$$

or, $\cos^2\theta + \mu^2\{\cos(A - 2r) - \cos A\} \cos\theta + \mu^2\{1 - \cos A \cos(A - 2r)\} - 1 = 0 \quad . (5)$

Equation (5) is a quadratic equation yielding

$$2\cos\theta = - \mu^2\{\cos(A - 2r) - \cos A\} + [\mu^4\{\cos(A - 2r) - \cos A\}^2 + 4 \{\mu^2\cos A\cos(A-2r)-(\mu^2-1)]^{1/2}, \quad 0<\theta<180° \qquad (6)$$

Equation (6) indicates that as cos(A-2r) increases, cosθ increases, that is, θ decreases By virtue of equation (2), the deviation D of the ray decreases with the decrease in θ Hence, the minimum deviation occurs when cos(A-2r) is maximum, i e

$$\cos(A - 2r) = 1$$

$$\text{or, } A - 2r = 0$$

$$\text{or, } r = A/2 = r'$$

so that $i=i'$ .. (7)

Consequently equations (2) and (3) give the angle of minimum deviation, $D_{min} = 2i-A$ Using this in equation (1), we get

$$\sin (D_{min} + A)/2 = \mu \sin r \quad . . (8)$$

Method II

We can also obtain the same result using the method of maxima and minima in calculus The condition in the present case is

$$\frac{d\theta}{dr} = \frac{dD}{dr} = 0 \qquad . (9)$$

for the optimum value of angle 'r' entailing D_{min} i e θ_{min} from equations (2) and (5). Differentiating equation (5) with respect to r, we get

$$\sin^2\theta \frac{d\theta}{dr} = \mu^2[- 2\cos A \sin (A - 2r) - \{\cos (A - 2r) - \cos A\} \sin\theta \frac{d\theta}{dr} + 2\sin(A - 2r) \cos\theta] \qquad . (10)$$

which in consequence of equation (9) gives

$$\sin(A - 2r) = 0$$

$$\text{or, } A = 2r, \text{ i e } r = A/2 \qquad .. (11)$$

Differentiating equation (10) with respect to r and utilizing equations (9) and (11), we get

$$\mu^2[4\cos A \cos(A - 2r) - \{\cos(A - 2r) - \cos A\} \sin\theta \frac{d^2\theta}{dr^2} - 4\cos(A - 2r) \cos\theta] - \sin 2\theta \frac{d^2\theta}{dr^2} = 0 \qquad (\text{since } A=2r)$$

$$\text{or, } \frac{d^2D}{dr^2} = \frac{d^2\theta}{dr^2} = \frac{4\mu^2 (\cos A - \cos\theta)}{\sin 2\theta + 2\mu^2 \sin^2 (A/2) \sin\theta} > 0$$

$$(A = \theta - D)$$

which entails minimum deviation of the ray for equation (11) i e for equation (7).

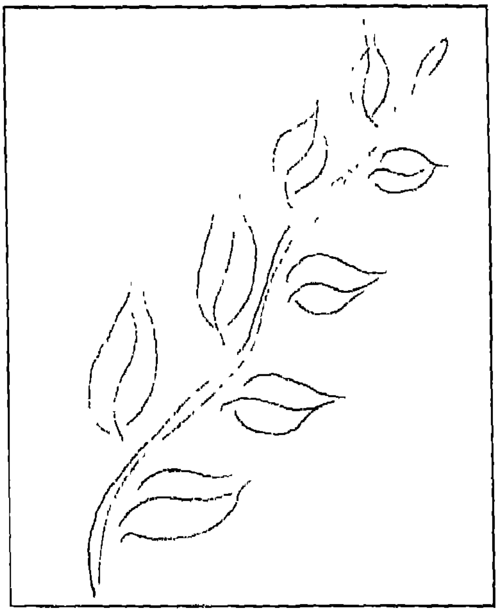
REFERENCES

1 D P Acharya, 1970 Optics, Oxford and IBH Publishing Co , Calcutta.

2 Francis A Jenkins and White, 1950, Fundamentals of optics, McGraw Hill Book Company Inc, London.

Chronological Review of Polymer Sciences

A.J. Umoudoh and I.O Essien
Department of Chemistry/Biochemistry
University of Uyo, Uyo
Akwa Ibom State, Nigeria, W/Africa



Polymer science is the study of the chemistry and physics of higher molecular weight substances. Polymers or macromolecules are high molecular weight substances composed of molecules characterised by the multiple repetition of one or more species of atom or group of atoms linked together in amount sufficient to provide a set of properties that do not vary markedly with addition or removal of one or few of the constitutional units

Macromolecules had been in existence since the beginning of life with mankind Even before the dawn of civilization, naturally occurring polymers were used by mankind for various purposes e.g. food (proteins, polysaccharides), clothing (silk, wool, fur), fuel (wood). Wood is also used for various building and construction purposes Amber — high molecular weight resin— has been worn as jewels and asphalt used as adhesive has been in existence in Bible times about 600 BC. Although the uniqueness in properties of natural and synthetic polymers were recognised as far back as the beginning of chemistry itself, the study of the physics and chemistry of these materials did not gain widespread acceptance before the 1930s. The major problem encountered by the early investigators was how to differentiate between colloidal and macromolecular substances.

It was the first time in history that H Staudinger first coined the word "Macromolecules" for high molecular mass substances in 1920 His ability to classify colloidal dispersion as micellar colloids (association colloids) and colloidal molecules (macromolecules) forms the basis of the modern day colloid science as distinguished from polymer science (Staudinger 1920) The word "polymerisation" and "polymer" was first introduced by M Berthelot in 1866 while observing liquid styrene turning into solid mass, he referred to the reaction polymerisation and the product as polymer

The history of the emergence of polymer science from past to present is inexhaustive, hence this paper highlights the remarkable discoveries and dates of important events in this field particularly for the periods between the 1800s to the 1970s Below is a chronology of the important events with dates:

Year	*Events*
1806	Discovery of natural rubber and experiments with elasticity of rubber by Gough in England
1838	Polymerisation of Vinylidene-chloride via sunlight by Regnault in France.
1839	Polymerisation of polystyrene by Simon
1859	Conversion of ethene oxide to poly (ethene oxide) by Wurtz
1860	Conversion of Vinyl halides into polyethene halides by Lourenco
1862	Synthesis of cellulose nitrate into polymer and was named 'celluloid' by Alexander Park in USA
1868	Synthesis of celluloid by mixing pyroxin with dilutenitric acid and camphor by Wesley Hycetl Patented his product and made public his result
1870	Commercialisation of celluloid by Hycetl as the first synthetic polymer.
1871	Polysaccharides and proteins classified as polymers by Hlaiwetz and Habermann
1884	Formula for sugars as polymers were established by Emil Fischer in Germany
1888	Molar masses for natural rubber was determined as between 6000 and 1200 g/mole by Gladstone and Hibbert.
1889	Determination of molar masses for starch up to 30,000 g/mole using cryoscopy by Brown and Morris
1909	Synthesis of the first phenolic polymer-phenolformaldehyde-the oldest known thermoset by Lee Hendrock. This was 41 years after the production of celluloid, the first synthetic polymer by Hycetl
1920	Macromolecular Hypothesis was put forward that polymeric substances are held together by partialvalence with saturated end groups by Staudinger
1929	Synthesis of condensation polymers — nylon, chlorprene with its analogs and homologs marketed today as neoprene Classification of polymers as condensation and addition polymers by Carothers (1929, 1931)
1930	Derivation of mathematical models for polymer configuration and theory of rubber elasticity by Kuhn, Guth and Mark in Germany
1930-1940's	Slow pace of development in the advancement of polymer science It was when the principles of Organic and Physical chemistry were applied to polymers that there was remarkable progress in the field.
1935	Development of methods for the determination of various molecular weight averages number, weight and viscosity average molar masses for polymers by Lansing and Kraemer.
1937	Elucidation of the mechanism for chain reaction polymerisation (Flory 1937)

1950s	Synthesis of stereospecific polymers and introduction of tacticity to polymers by Natta (1955)
1960s	Nuclear magnetic resonance applied to polymer structure analysis Gel permeation chromatogry GPC analysis for molecular weight distribution of polymer. Introduction of differential scanning calorimetry for determination of melting point of polymers
1975	Manufacture of linear low density (LDPE) and high density (HDPE) polyethylene by Phillips Co in UK.

Major Uses of Polymer in the Present Era

Polymers have been found useful in almost all fields — such as textile, medicine, automobile, communications, agriculture, aerospace, dentistry, metallurgy, meteorology, upholstery, transportation, recreation and sports, pharmacy, building constructions just to mention a few In medicine polymers are used as sutures, implants, artificial hearts and kidneys of polypropylene, polysiloxanes and polytetrafluoroethane have been reported (Amaly 1962). Polycarbonate with its blends have been used as blood centrifuge tubes, anesthesia canisters or blood oxygenerators. In the automobile industry polymers such as nylon 6,6 are used for construction of speedometer gear cable, jacketing for car brakes, carburettor components Polymers such as polytetrafluoroethene have been used as rotating antenna and radar in space engineering, polyphenylene sulphide (PPS) used as seal for aircraft, gear, bearing and also in oil drilling equipments.

The following table shows a selection of some polymers and their uses

Polymer	*Uses*
Polythene (PE)	Film for packaging, sewage pipes, canopies, artificial kidney, splint implants, bottles, tooth brush, diary and pepsi cola crests, carpets.
Polypropene (PP)	Screw cap, woven sacks, ropes, buckets, sutures, rackets, bags, mosquito nets, tarpaulins
Polyvinyl choride	Floor tiles, carpets, sewage pipes, rain coats, leather, table cloth etc
Polytetra-fluoroethene	Non-stick kitchen ware, aircraft and missile components, hip joint prosthesis etc
Acrylonitrile butadiene - Styrene terpolymer	Motor parts, gear box, business machine parts, door knobs, TV cabinets, camera parts, domestic blender and mixers etc
Nylon 6,6	Tire cords, gears, rollers, conveyor belts, rackets, bullet resistant glazing materials etc
Polmethyl methacrylaste	Adhesives, lenses, lighting signs, dials and medallions, artificial tooth, reflectors, car light housing (head lamp), shower cabinets etc
Acetal resins	Automotive door handle, wheel covers, gas caps, shower heads, telephone parts, lawn sprinklers lavatory faucets etc

Poly-carbonates	Business machine housing, plastic needles, electrical/electronic equipments, aircraft parts etc.

The list is inexhaustive as one polymer can find application in various fields of human endeavour

Need to Intensify Research in Polymers

Though polymers have been found very useful in many applications, but in certain applications where toughness, high abrasion, modulus, tensile strength and other properties withstanding aggressive environment, high temperatures are concerned ceramics and metals have been found to be more useful than polymers Most polymeric materials do not possess all the desirable qualities such as rigidity, heat resistance, weatherability, dimensional stability, flame resistance, moisture/chemical resistance, impact resistance required by the production engineer.

There is need for more research into properties of polymers for production of quality engineering and speciality plastics designed to meet specific requirements in which metals or ceramics have been found useful. There is need for research in the area of the production technology, design, selection of materials with the optimum combination of factors necessary for production of quality plastics.

Comparison of the Pace in development of Polymer Science and Technology

In the 1800s the pace of development of the science and technology of macromolecules was rather slow. It was not until the 1930s to 1940s that there was remarkable progress in the science of plastics particularly as a result of the widespread of the famous 'Macromolecular Hypothesis' put forward by Herman Staudinger in 1924 The application of the principles of organic and physical chemistry to the elucidation of polymer structures has enhanced in no small measure the understanding of the nature of these 'modern materials' To be specific the genesis of plastic material dates as far back to 1868 when Wesley Hycetl manufactured the first plastic called celluloid (cellulose nitrate)

After 41 years in 1909, Lee Hendrock synthesized the first synthetic polymer-phenol-formaldehyde, other polymers such as polevinylacetate and nylons were produced in the 1920s. A selected chronology of commercial polymers and their initial uses at time of invention is mentioned on next page

As a result of intensive research in the field of polymer chemistry, physics and technology, new speciality and engineering plastics are in common use today

Conclusion

The foregoing treatise on the history of high polymers emphasize the need for more research and education in polymer science at all levels of education. We encounter polymeric materials in everyday life and hence there is a need for students of science in particular to be acquainted with the knowledge of these materials,

Date	*Material*	*Typical Use*
1868	Cellulose nitrate	Eye glass frames
1909	Phenol-formaldehyde	Telephone hand-set
1919	Casein	Knitting needles
1926	Alkyd resins	Electrical bases
1927	Cellulose acetate	Tooth brushes, packaging
1927	Polyvinylchloride	Rain coats
1929	Urea-formaldehyde	Lighting fixtures
1935	Ethyl cellulose	Flash-light cases
1936	Acrylics	Brushes backs, displays
1936	Polyvinylacetate	Flash bulb lining
1938	Polystyrene	Kitchen housewares
1938	Nylon 6,6	Gears
1939	Polyvinylidene chloride	Auto seat covers
1939	Melamine-formaldehyde	Tableware
1942	Polyester	Boat hulls
1942	Polythene	Squeezable bottles
1943	Polyfluorocarbons	Industrial gaskets
1943	Polysilicones	Motor insulation
1945	Cellulose propionate	Pens and pencils
1947	Epoxy resins	Tools and jigs
1948	Acrylonitrile- butadiene-Styrene terpolymer	Luggages
1949	Allylics	Electrical connectors
1954	Polyurethane	Foam cushions
1956	Acetals	Automotive parts
1957	Polypropene	Safety helmets
1959	Chlorinated polyether	Valves and fitting
1962	Plyallomer	Typewriter cases
1964	Polyphenylene oxide	Battery cases
1964	Ethylene-Vinylacetate	Heavy gauge flexible sheeting
1965	Polysulfone	Electrical/Electronic parts
1970	Thermoplastic polyester	Electrical/Electronic parts
1973	Polybutylene	Piping
1975	Nitrile resins	Containers

REFERENCES

1. Amaly, M.F, 1962 Arch. Opthalmol *68 390.*
2. Brown, H T. and Morris, G H, 1889 Molecular Weight of Starch J Chem Soc. (London) 53·679

3 Carothers, W L , 1929 An Introduction to general theory of condensation polymers J Am Chem. Soc. *51.*

4 Carothers, W L , 1931 Polymerisation Chem Revs. *8* , 353 - 426

5 Flory, P J "Mechanism of Vinyl Polymerisation". J Am Chem Soc 59;241-253

6 Gladstone, J.H and Hibbiet, W , 1888 · Molecular Weights of Natural Rubber J Chem. Soc. (London) 53 : 679

7 Hlasiwetz, H. and Habermann, J., 1871 Proteins and Polysaccharides Ann Chem Pharmacol 159 . 304

8 Lansing, W D and Kraemer, E O , 1935 Molecular weight analysis of mixtures by sedimentation equilibrium in the Svedberg ultracentrifuge J Am Chem Soc. 57 . 1369-1377

9 Lourenco, A V., 1860 Reactions of ethene halides Compt Rend 51 ; 365

10 Natta, G , 1955 A new class of x-olefin polymers with Exceptional Regularity of structures (French) J Poly Sc *16.*143-154

11. Staudinger, H , 1920 · Polymerisation (in German) Ber 53B.· 1073-1085

12. Simon, E , 1939. Reaction of Styrene to polystyrene Ann. Chim Phys. 31.265.

13 Wurtz, A , 1859. Conversion of ethene oxide to poly (ethene oxide) In . Macromolecules (ed George Hen Elias. 1973

A Biography of Mighty Uranium

K.K MISHRA
Homi Bhabha Centre for Science Education
TIFR, V N Purav Marg
Mankhurd, Mumbai-400088

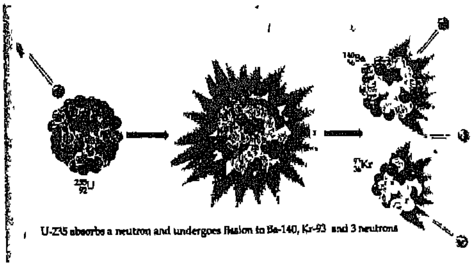
My God! What have we done? .were the words uttered in surprise by the co-pilot in the cockpit of the Enola Gay, the B-29 bomber of the US airforce which dropped the first atom bomb on Hiroshima on 6 August, 1945 The atom bomb, code name 'Little Boy' was a uranium bomb that brought about unimaginable misery and destruction to life and property, and the world, for the first time, came to know the devastating might of uranium. Though dropping of atom bomb helped ending the prolonged World War II but it started a new era in the history of mankind and led to cold war The world was stunned to know this catastrophic power of atom bomb The co-pilot saw the city wrapped in dust and smoke and felt as though the city was boiling like a soup It was like a volcanic eruption reaching the altitude of about 13 km. Within moments 88 thousand people were killed and some 60 thousand wounded. This was the biggest and the most heinous massacre since the dawn of human civilization on this planet Since then, uranium has become a symbol of terror.

Uranium is the heaviest naturally occurring element of the periodic table with atomic number 92 Uranium is a silvery white, lustrous, malleable, ductile and radioactive metallic element It is the most abundant radioactive element in the Earth crust Its melting and boiling points are 1132° and 3718°C respectively. Its specific gravity is 19 05 and valencies are 3, 4, 5 and 6 It has three allomorphic forms. Uranium was discovered by German chemist Martin Klaproth in the pitchblende in 1789 and was named after Uranus, the seventh planet of our solar system which was discovered a few years before, in 1781, by the British astronomer William Herschel. But the metal itself was extracted in pure form by Eugene Melchior Peligot very late in 1841 by reducing uranium tetrachloride with potassium

Henery Bacquerel in 1796 reported the phenomenon of radioactivity in uranium It is found abundantly in the USA, Canada, Australia and South Africa Beaverlodge region in Canada is so rich in uranium ore that it is called as 'uranium city All the elements after uranium are called 'trans-uranic elements'.

Uranium has three isotopes, U-238, U-235, U-234. Out of these three, first one is most abundant and comprises 99 per cent and U-235 is just 0 7 per cent. Uranium is a radioactive element and emits alpha and beta particles since nucleus is unstable and undergoes decay After spontaneous disintegration uranium is converted into various other elements and ultimately changes into stable lead It is a poor conductor of electricity and readily reacts with other elements to form various compounds which are very poisonous U-235 is fissile and after bombarding with neutrons its nucleus is split into lighter nuclei. The number of neutrons play an important role in deciding the stability of nucleus. If the neutron and proton ratio i.e. n/p is greater than 1.5, nuclei are unstable and have tendency to disintegrate The principle ores are carnotite, pitchblende, and uranitite. In our country uranium ores are found in Jaduguda mines of Singhbhoom district in Bihar.

The idea that matter and energy can be interconverted was given by Albert Einstein, the great physicist of twentieth century. Theoretically he proved that matter and energy relationship can be shown by the equation E=mc^2 (where E stands for energy, m for mass and c for velocity of light) Einstein calculated that 1 pound (0.454 kg.) of matter can generate as much energy as can be obtained by burning 3 million tons of coal. Uranium became a subject of intense study when Otto Hahn and Fritz Strassman discovered in late 1938 that uranium nucleus undergoes fission after bombarding with slow neutrons (Fig 1) Enerico Fermi in 1939 found that neutrons might be among the fission products and could thus continue the chain of the fission reaction (Fig. 2). Later on, it was confirmed that 2-3 neutrons on average are produced by fission of every nucleus Though uranium fission has various modes but Barium and Krypton are main products.



U-235 absorbs a neutron and undergoes fission to Ba-140, Kr-93 and 3 neutrons

FIG 1

This was the time of Second World War and several countries were working on the line to get a weapon in hands to emerge victorious. The atom bomb was the dream of those days In the efforts the USA went ahead and succeeded in making the first atom bomb based on plutonium which was tested in Alamagordo in New Mexico on 16 July 1945. Soon after that a uranium

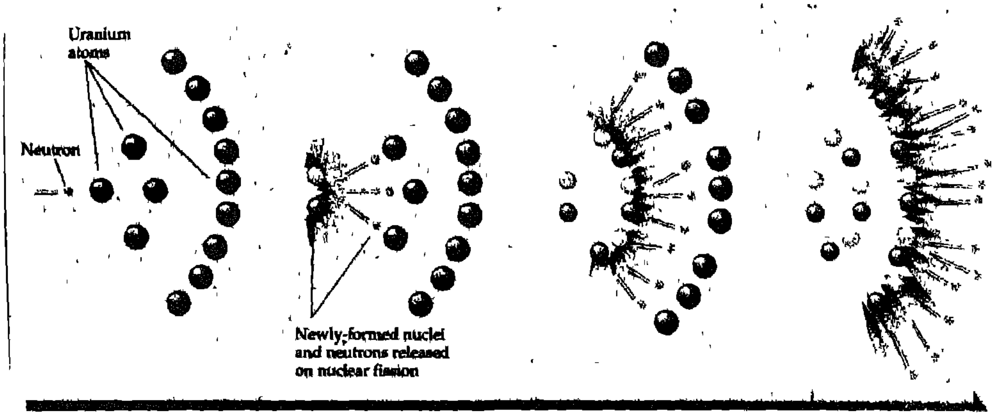

Uranium atoms
Neutron
Newly-formed nuclei and neutrons released on nuclear fission

FIG 2

bomb called 'Little Boy' was made and dropped on Hiroshima on 6 August 1945 For making a bomb U-235 has to be enriched This enriched mass is kept separately in small pieces whose masses are less than critical mass. The undercritical mass cannot sustain a chain reaction With the help of a conventional technique all the undercritical masses are joined together which form a supercritical mass paving way to sudden explosion with the release of tremendous amount of energy. This was the one side of the picture The power of nuclear reaction is used for beneficial purposes also With nuclear reactor we generate electricity. A schematic diagram of an atomic power plant is shown in Fig 3. At present over 400 atomic power plants are working in the world generating 20 thousand megawatts of power. Undoubtedly uranium is the element of this century. Of course, it is mighty but it is up to us whether we use it to make or mar the human civilization.

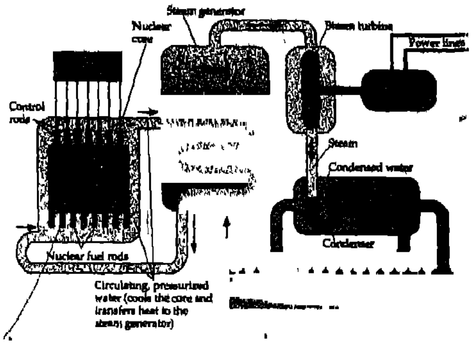
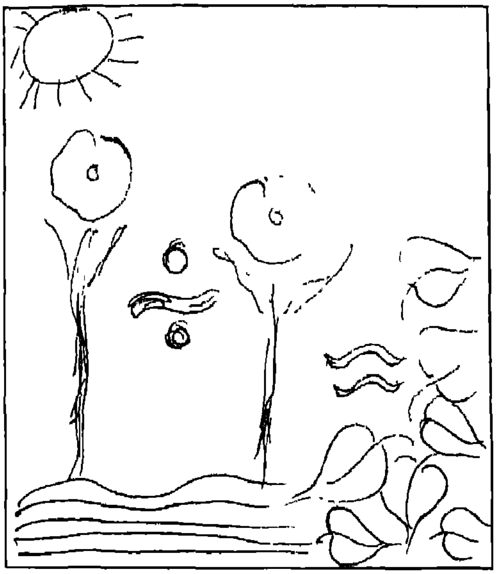


FIG 3

A Method for Deriving the Power Sum Formulae i.e. Σn^k

A.S Nimbran, I P.S
D.I.G of Police
Tirhut Range
Muzaffarpur (Bihar) 842001



We know that

$$\Sigma n(n+1)\,(n+2)\ldots\ldots(n+m) = \frac{n\,(n+1)\,(n+2)\ldots(n+m+1)}{m+2} \qquad (1)$$

It may be noted here that m+2 equals the number of factors in the numerator

I shall use (1) to derive the formulae for Σn^k.

Thus for $m=\phi$, we get from (1)

$$\Sigma n = \frac{n(n+1)}{2} \qquad (2)$$

We know that

$$n^2 = n(n+1) - n$$

$$\therefore \Sigma n^2 = \Sigma n(n+1) - \Sigma n$$

$$= \frac{n(n+1)\,(n+2)}{3} - \frac{n(n+1)}{2}$$

$$= n(n+1)\left[\frac{(2n+4)-3}{6}\right]$$

i e $$\Sigma n^2 = \frac{n(n+1)\,(2n+1)}{6} \qquad (3)$$

we know that

$$n^3 = n(n+1)\,(n+2) - 3n^2 - 2n$$

$$\therefore \Sigma n^3 = \Sigma[n(n+1)(n+2)] - 3\Sigma n^2 - 2\Sigma n$$

$$= \frac{n(n+1)(n+2)(n+3)}{4} - \frac{3n(n+1)(2n+1)}{6} - \frac{2n(n+1)}{2}$$

$$= \frac{n(n+1)}{2}\left[\frac{(n+2)(n+3)}{2} - \frac{3(2n+1)}{3} - 2\right]$$

$$= \frac{n(n+1)}{2}\left[\frac{n(n+1)}{2}\right]$$

$$= \left[\frac{n(n+1)}{2}\right]^2$$

Similarly, $\Sigma n^4 = \Sigma\, n(n+1)(n+2)(n+3) - 6\Sigma n^3 - 11\Sigma n^2 - 6\Sigma n$

$$= \frac{6n^5 + 15n^4 + 10n^3 - n}{30} \qquad (4)$$

This way, we can derive all the sum formulae for higher powers. We can express n^k in terms of both $n\pm1$, $n\pm2$, $n\pm3$, and so on

For example,

$$n^2 = (n-1)n + n$$

$$\therefore \Sigma n^2 = \Sigma(n-1)n + \Sigma n$$

$$= \frac{(n-1)n(n+1)}{3} + \frac{n(n+1)}{2}$$

$$= n(n+1)\left[\frac{n-1}{3} + \frac{1}{2}\right]$$

$$= n(n+1)\left[\frac{2n-2+3}{6}\right]$$

$$= \frac{n(n+1)(2n+1)}{6}$$

$$\Sigma n^3 = \Sigma(n-1)n(n+1) + \Sigma n$$

$$= \frac{(n-1)n(n+1)(n+2)}{4} + \frac{n(n+1)}{2}$$

$$= \frac{n(n+1)}{2}\left[\frac{(n-1)(n+2)}{2} + 1\right]$$

$$= \frac{n(n+1)}{2}\left[\frac{n^2+n-2+2}{2}\right]$$

$$= \frac{n(n+1)}{2}\left[\frac{n^2+n}{2}\right]$$

$$= \frac{n(n+1)}{2}\left[\frac{n(n+1)}{2}\right]$$

$$= \left[\frac{n(n+1)}{2}\right]^2$$

This way of expressing n^k in terms of both $n+k$ and $n-k$ simplifies computation.

Excellence in the Science Curriculum

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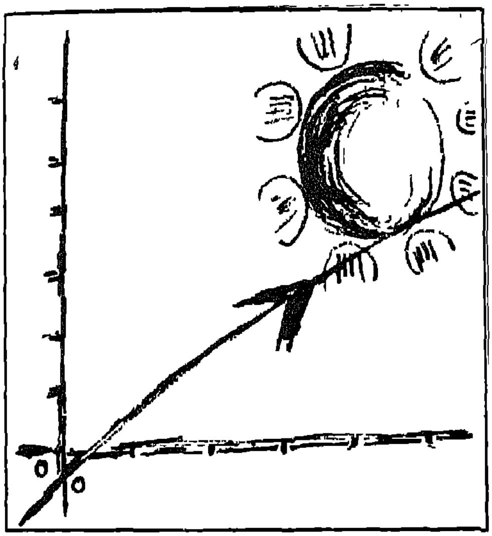


Each person lives in a world of science. The natural environment affects all of us. It operates in terms of scientific theories, principles, and laws. Pupils in the public school setting need to achieve relevant goals in science These goals should be attainable, meaningful, and possess purpose for the learner. *The Show Me Standards*, (1996) list the following science objectives for pupil achievement in Missouri schools

In science, students in Missouri public schools will acquire a solid foundation which includes knowledge of

1 properties and principles of matter and energy
2. properties and principles of force and motion
3 characteristics and interactions of living organisms
4. changes in ecosystems and interactions of organisms with their environment
5. processes (such as plate movement, water cycle, air flow) and interactions of Earth's biosphere, atmosphere, lithosphere, and hydrosphere
6. composition and structure of the universe and the motions of objects within it
7. processes of scientific inquiry (such as formulating and testing hypotheses)
8. impact of science, technology and human activity on resources and the environment.

Each of the above named objectives should be emphasized within a related, designated unit of study The objectives might also be written more precisely, if desired, so that it can be measured if a pupil has/has not achieved each stated end of instruction. There are states in the United States that mandate measurably stated objectives Other states have a more open-ended approach in allowing leeway in writing objectives. I recommend that objectives not be written so precisely that facts only are emphasized on tests to appraise pupil achievement. The following objective stresses pupils memorizing facts· the pupil will list in writing the names of ten arthropods. Then too, objectives can be so broadly stated that they become meaningless such as "The pupil will learn science" This objective certainly lacks clarity in terms of what will be taught and evaluated to determine pupil achievement

To improve the quality of life for each person, a problem solving approach should be emphasized in ongoing lessons and units in science. With problem solving, change occurs from what is to what should be in science.

Diverse schools of philosophical thought will be discussed and how each might relate to improve the science curriculum

Realism in the Science Curriculum

A science teacher who is a realist emphasizes that one can know the real world, in whole or in part, as it truly is. The mind then does not modify or change what is being perceived Tillman, Berofsky, and O'Connor (1971) wrote, "Most people when they think about the objects of perception, would say that they perceive a world of objects which is external to them and which exists independently of their perception of it This view is called realism".

Since the external world is perceived the way it is in actuality, specific objective of instruction can be determined by scientists and science educators for pupils to achieve. Each objective must be relevant and is a part of the whole that can be known by the learner Thus in geology, biology, chemistry, physics, and astronomy, among other academic disciplines, measurably stated objectives of instruction need to be emphasized in teaching and learning in the science curriculum. With quality learning opportunities selected by the science teacher, pupils either achieve or do not achieve the specific objective(s) as a result of instruction Measuring pupil achievement in learning stresses what pupils have learned what was stated in each objective Realists desire observable results in learning from pupils. The results are verifiable regardless of which teacher is appraising learner progress The verification principle is very important to teachers of science who adhere to realism as a philosophy of instruction

Skinner (1979) was a leading advocate in stressing precise objectives for pupil attainment Reinforcement is emphasized to reward correct/good responses in learning Observable, measurable results are obtained from what pupils have achieved Guesswork is not involved, but per cents, standard deviations, quartile deviations, grade equivalents, and percentile ranks emphasize how well each pupil is doing in the area of science instruction. Numerical results of pupil achievement in science is wanted by the realist teacher Scores form tests; objective evaluations of science experiments and demonstrations performed by pupils, ratings given to learner performance as well as responses to questions, oral reports, portfolios and related papers written in which interobserver reliability is in evidence, present data as to how well pupils are achieving These procedures qualify as objective means of appraising learner progress

Mager (1972) stressed the importance of writing objectives so they are operationalized Objectives are then specific and clear to teachers, pupils, and other interested persons Learning opportunities may be chosen and aligned with the stated objectives. Appraisal procedures used to determine pupil achievement are also aligned with the objectives. Quality validity and reliability are then in the offing A pupil reveals if he/she attained for did not attain a stated objective. The realist science teacher wishes to know if pupils individually are or are not achieving objectives of instruction. The results may then be reported to parents in a very precise way.

Prior to instruction, the teachers may announce to pupils which objectives will be emphasized in the science lesson or unit The pupil knows exactly what will be expected in terms of knowledge or skills to be obtained The involved pupil should have more confidence in learning when realizing what the instructor's expectations are. The science teacher might desire to arrange the objectives in an ascending order of complexity A logical sequence follows since the teacher sequences objectives in science for the pupil to achieve

Advantages given for emphasizing realism as a philosophy of instruction are the following .

1. teachers may realize how successful they are in teaching since results form pupil learning are clear and observable
2. objectives, learning activities, and evaluation procedures are interrelated in that the learning activities and the evaluation procedures must harmonize with the stated objectives Thus for example, it becomes easier to choose learning activities than otherwise would be the case due to the harmony needed between these activities and the stated objectives
3. effective schools research states that pupils achieve better if there is a clear relationship between the learning activities and the evaluation procedures with that of the objectives of science instruction (Edmonds 1982)

Disadvantages given for emphasizing realism as a philosophy of education stress the fragmented knowledge that pupils may learn since each objective achieved emphasizes parts of a whole The teacher controls the science curriculum since he/she determines the objectives, learning opportunities, and evaluation procedures, pupils are not involved here in decision making. The products of instruction in science are emphasized, leaving little room for processes such as abstract thinking which is rather difficult to measure

Examples of precise objectives for pupils to achieve in science are the following:

1. The pupil will write a paragraph indicating seven animals involved in a food chain.
2. The pupil will make a drawing showing ten animals in a forest food web and their interactions.
3. The pupil will list in writing the names of five parasites and their respective hosts
4. The pupil will define each of the following· producers, consumers, decomposers, symbiosis, and an aquatic/land community.

Experimentalism in the Science Curriculum

Experimentalists stress a problem solving approach in the curriculum They emphasize that individuals cannot know the real world as it truly is. Individuals, however, obtain experiences of this reality. With experiences, changes occur in one's thinking and believing A changing world makes for problematic situations. Problems need identification and solutions sought In the science curriculum, pupils with teacher guidance select a problem within an ongoing lesson or unit of study. The problem needs to be adequately delimited so that meaning and understanding is involved A hypothesis is developed directly related to the stated problem Information from a variety of sources is used by learners to arrive at a tentative solution. Experimentalists believe all knowledge to be tentative, not absolute. The result might well involve changing and modifying the original hypotheses The new hypothesis is then tried out in a concrete situation (Geiger 1955) Problem solving may be used in all curriculum areas and in life itself. Knowledge here is used to solve problems and is not an end in and of itself. The practical and the utilitarian are emphasized within the framework of problem solving knowledge secured from a variety of sources has an application dimension. Knowledge then is useful to solve problems in a changing world, science included (Ediger 1995)

Experimentalists emphasize that school and society are one, not separate entities Since groups in society select and solve problems, pupils in committees also need to be involved in cooperative learning stressing problem solving School and society are one, not separate entities Dewey (1915) is still very widely recognized as a leading advocate of experimentalism in teaching and learning In integrating the learner with the self as well as with the societal arena, he advocated four characteristics of pupils which have wide implications for the teaching of science These are that pupils possess the social impulse in that they desire to work together with others in the curriculum; the constructive impulse in which learners like to learn by doing, not being passive individuals; the investigative and experimentation inclination whereby pupils desire to learn by discovery rather than being told and lectured, and the creative or expressive impulse, rather than have rigid formal expectations for achievement

Advantages given in emphasizing experimentalism as a philosophy of teaching science are the following.

1. Pupil interest in science becomes paramount when they with teacher assistance identify problem areas. Interest in learning makes for effort in achieving
2. Very young pupils in early primary grades may be involved in problem solving experiences (Ediger 1994)
3 Problem solving is useful in all curriculum areas and in life itself when problems are selected and solutions sought

Disadvantages of using experimentalism as a philosophy of education include problem selection being too difficult as well as problem solving may not be a favorite style and way of learning for a few pupils Also motivation may be lacking for some pupils to identify and solve problems.

The following are examples of possible problems for pupils to solve

1 How do animals adapt to their natural environment?
2 How do cells differ in size and shape to fulfill their unique functions? How are cells similar in features possessed?
3 How do unicellular and multicellular organisms differ from each other?
4. Which life processes do all living things perform?

Pertaining to John Dewey's philosophy of experimentalism, Meyer (1949) wrote·

All of this, of course, depends upon in no small way on thinking For Dewey, however, thinking becomes significant only when applied to life situations It is, he has said, "an instrumentality used by man in adjusting himself to the practical situations in life." Or to phrase it more simply, human beings think in order to live Because of this stimulus, which has its basis in biology and sociology, it is impossible — it is absurd — to interpret life in a systematic and abstract way. Since, moreover, Dewey holds that life is in constant flux, it is impossible to solve problems with any degree of finality for the problems of tomorrow will be different from those of today.

As for the problem of knowledge, Dewey believes that knowledge and true experience is functional. What is this thing for? What is its use? Is 'a coal mine a physical deposit or does it have function? and if so, what is it? Such are the questions that help to give meaning to one's experience; but such questions cannot be answered without antecedent action. Action must precede knowledge Whatever knowledge we possess has resulted from our activities, our efforts to survive, to obtain food, shelter, and clothing Only that which has been organized into our disposition so as to enable us to adapt to our environment to meet our needs and to adapt our aims and desires to the situation in which we exist is really knowledge.

Idealism in the Science Curriculum

Idealists believe that one can receive ideas about the real world only Thus one cannot know the real world as it truly is independent of the observer Mental development in idealism becomes of utmost importance since an idea centered world is in evidence Mind is real and needs development As a leading idealist still quoted widely presently, Horne (1932) stressed the importance of the use of reason and rational thought in arriving at truth. Concepts and generalizations or universals such as justice, truth, goodness, ethics and beauty have always existed and can be discovered by human beings. These universals are a priori, to an idealist, in that they have existed prior to human experience.

A subject centered curriculum in science is of paramount importance In science lessons and units of study, pupils should achieve vital concepts, and generalizations Depth teaching is needed to cultivate the intellect in guiding pupils achievement in science A multimedia approach in leaning is needed to assist pupils to achieve abstract ideas in science. The abstract to an idealist is superior to the concrete and semiconcrete in learning The concrete and semiconcrete facets of learning in science are salient to the degree that learners attain the abstract such as vital facts, concepts, and generalizations in ongoing lessons and units of study Since reading and writing, in particular, stress abstract learnings, they should not be minimized in the science curriculum

To emphasize a subject centred curriculum as idealists recommend, an academically inclined teacher needs to teach in a scholarly way so that objectives stressing intellectual goals are attained by pupils. Blanchard (1964) wrote '

> The aim of thought from its very beginning, we saw, was at understanding. To understand anything meant to apprehend it in a system that rendered it necessary The ideal of complete understanding would be achieved only when the system that rendered it necessary was not a system that itself was fragmentary and therefore contingent, but one that was all-inclusive and so organized internally that every part was linked to every other by intelligible necessity

Advantages given for emphasizing idealism as a philosophy of teaching science include the following:

1. pupils are to achieve significant subject matter Idealism emphasizes the acquisition of vital content in science that pupils need to attain. Uses made of knowledge in science need to emphasize what is just to all, what is truthful, what is good in its application, what will truly stress ethical dimensions, and that which has beauty in its aesthetical areas
2. many pupils may be motivated to learn when an academic approach to learn science is stressed This might be especially appealing to the gifted and talented learners in science. All pupils need motivation to achieve and learn in science
3. the abstract in idealism is preferred to the concrete and semiconcrete, relevant concepts, and generalizations, and other universals emphasize abstract goals in science teaching Idealist advocate wholeness in knowledge, not fragmentation Knowledge is related in all of its manifestations

Disadvantages given for idealism as a philosophy in teaching and learning include minimizing a hands on approach in learning science since the focal point of teaching is to have pupils develop well intellectually, placing emphasis upon universals much more so than specifics — the latter is salient in pupils arriving at conclusions such as in science experiments; and integrating of knowledge to the point where science as a discipline is not as clearly defined as it might be Idealists tend to stress that which goes beyond the five senses. Thus metaphysics and the a priori are salient to an idealist

Quality sequence in science might be slighted when abstract phases of learning are more prized more highly than the concrete and semiconcrete Most educators presently recommend a sequence of concrete, semiconcrete, to the abstract in teaching-learning situations. Quite similar in sequence, Bruner (1968) advocated using manipulative materials such as objects and items, followed by iconic materials such as audiovisual materials which are one step removed from the manipulative phase; and then symbolic activities which stresses the abstract including reading and writing

Objectives in science, according to idealism as a philosophy of education, might well stress the following universal topics ·

1. monerans such as bacteria and blue green algae. Monerans are prokaryotes in that they have no true nucleus They consist of producers, consumers, and decomposers A few move around whereas others are stationary.
2. protists, such as paramecium, euglenas, diatoms, and cribaria. Protists are unicellular and have a true nucleus With a true nucleus, protists are eukaryotes, and are producers as well as consumers
3. fungi, such as mushrooms and bread molds Most fungi are multicellular. Since fungi do not contain chlorophyll, most are decomposers with a few being consumers.
4. plants, such as mosses, liverworts, ferns, and seed plants Plants are eukaryotes and are producers. Plants do not move from one place to another

Pertaining to idealism, Bigge (1982) wrote :

> The heart of idealism is the belief that basic reality consists of ideas, thoughts, minds, or substantive selves, not physical matter. Since priority is given to minds, minds have bodies, but bodies do not have minds. Idealism carries with its view the idea of subsistence (the superexistence) of God, who also is basically mind or self The universe is an expression of intelligence and will; its order is due to an eternal, spiritual reality. For idealists, people are good-active substantive minds, they are absolutely real selves endowed with free will or genuine moral choice This philosophy has ancient roots; it dates back to Socrates (469-399 BC) and Plato (427-347 BC)

Idealism really is idea-ism. The source of this title is based on Platonic thought For Plato, ideas only are genuinely real, they consisted of immaterial essences That which people perceive is a shadow of reality; each thing that they perceive gets its existence from its Thingness, an idea A book is a book because of its being more or less an imperfect replica of Bookness A woman is a woman because she is a replica of Womanness. Plato's assumed world of "eternal verities" consisted of the True, the Good, and the Beautiful

We can trace the development of idealism by listing some of the leading philosophers who have contributed to this position and stating a leading idea that each has contributed to this philosophy. Socrates believed that children are born with knowledge already in their minds, but they needed help to recall this innate knowledge Plato contributed to the idea of Ideas, which are the universal forms of all existing things and are the essence of reality St Augustine (350-430) held a dualistic (mind-body) force of goodness.

Existentialism and the Science Curriculum

Existentialists believe that one exists

first and then finds his/her purposes in life; there are no standards to guide human beings other than those developed by the human race Most existentialists advocate that people are condemned to be free with no a priori standards in life. Individuals then make or break themselves due to the kind of society wanted. Each person chooses and makes choices continually To be human is to choose If a person permits the self to have someone else makes one's own decisions, then the individual ceases to be human

Combs (1972) stresses that the way individuals perceive a situation will assist in determining how the individual will behave Perception is unique to the individual. Each person decides upon what is true, judges what is good, and decides upon plans of action The science curriculum then must provide opportunities for pupils individually to decide what to learn, that is the objectives of instruction The pupil needs to be heavily involved in selecting learning opportunities as well as methods of determining progress. The teacher is a guide and encourages pupil learning The teacher, however, does not lecture nor determine the science curriculum for the individual pupil A learning centers approach in teaching science may then be emphasized Here, there are an adequate number of centers with quality tasks for learners at each center There needs to be more tasks than what a pupil can complete so that individual sequential choices may truly be made. A psychological, not logical, science curriculum is then in evidence. Each pupil may select tasks based on personal needs, interests, and purposes. The choice to be made is up to the individual pupil. If tasks do not meet personal needs of the involved learner, he/she might plan with the teacher what has merit and value to the pupil A contract system might also be implemented in which the pupil with teacher guidance selects tasks to put into a contract for completion The learner himself/herself is responsible for choices made. The individual perceives what is good and has quality Knowledge is subjective, not objective to the existentialist. For example, in a values clarification session, the pupil determines what is moral in terms of uses made of science and technology; the teacher has a difficult position as a stimulator and of one who encourages pupil learning. Being humane in an absurd environment is a major goal for pupil achievement in existentialist thought and thinking.

Within an existentialist science curriculum, through pupil/teacher planning a learner may select topics such as the following to pursue

1 How do pesticides and herbicides help or hinder the natural environment. This question pertains to curbing insects and weed growth for the raising of farm crops versus possible contamination of soil and water

2 How does one deal with animals in a humane way? This question stresses what to do with surplus dogs and cats roaming an area, as well as using animals for food and for scientific experiments

3 How can the natural environment be used for development so that adequate numbers of jobs are avail-

able for workers versus the destruction of natural habitats for wildlife?

4 How can the needs of individuals be met as well as those in the societal arenas? This raises the question of the individual versus the larger group in a community, state, nation, and the world

Alston and Brandt (1978) write the following direct quote of Jean Paul Sartre, a late leading existentialist·

Man is nothing else but what he makes of himself. Such is the first principle of existentialism It is also what is called subjectivity, the name we are labeled with when charges are brought against us. But what do we mean by this, if not that man has a greater dignity than a stone or table? For we mean that man first exists, that is, that man first of all is the being who hurls himself into the future and who is conscious of imagining himself being in the future Man is at the start a plan which is aware of itself, rather than a patch of moss, a piece of garbage, or a cauliflower, nothing exists prior to this plan, there is nothing in heaven, man will be what he will have planned to be Not what he will want to be. Because by the word 'will' we generally mean a conscious decision, which is subsequent to what we have made of ourselves. I may want to belong to a political party, write a book, get married, but all that is only a manifestation of an earlier, more spontaneous choice that is called 'will' But if existence really precedes essence, man is responsible for what he is Thus, existentialism's first move is to make every man aware of what he is and to make the full responsibility of his existence rest upon him And when we say that a man is responsible for individuality, but that he is responsible for all men

The Psychology of Education

Principles of learning from the psychology of learning give direction to the science teacher in teaching-learning situations in ongoing lessons and units of study. Ediger (1994) lists the following criteria upon which educational psychologists agree should be followed by teachers,

1. meaningful learning experiences should be provided to pupils in the curriculum.
2. interesting content and skills should be offered in lessons and units of study
3. purpose needs to be established within pupils for learning
4. quality sequence for pupil learning is a must.
5. rational balance among knowledge, skills, and attitudinal objectives is important in the instructional arena.

In Summary

Science teachers need to select tenets from the philosophy of education which stress pupils attaining vital content, abilities, and attitudes In reviewing the different philosophies of education discussed in this paper, the following is salient from each philosophy.

1. clarity in objectives of science instruction, carefully selected, as recommended by realists However, it is important to avoid fragmenting knowledge obtained by pupils
2. problem solving procedures as recommended by experimentalist. Life

in society emphasizes the importance of being able to solve personal and social problems.

3. major concepts and generalizations, as universals in science, advocated by idealists.
4. decision making opportunities in science as recommended by existentialists. Each person needs to learn to make decisions.

I believe that a problem solving philosophy encompasses the other three philosophies. I recommended problem solving as a major philosophy of education to emphasize in teaching science due to its relevance in the curriculum and in life itself. Problems abound and need solutions. Knowledge acquired then is instrumental or useful in problems to be solved which are selected by pupils with teacher guidance.

Ediger and Rao (1996) wrote the following in summarizing different psychologies of teaching :

Comparisons were made among the following models in teaching science :

1. problem solving with teacher guidance.
2. behaviorism with its predetermined precise objectives for student attainment
3. humanism and its emphasis upon students selecting sequential activities from among alternatives
4. the structure of knowledge with key concepts and generalizations identified by academicians in their respective areas of specialization Science teachers assist students to achieve these structural ideas inductively using methods and procedures of scientists in a science laboratory setting.
5. stimulus-response learning of students in which a specific response is associated with a precise stimulus

The writers advocate a problem solving approach be utilized in teaching science From a stimulating learning environment in science, students with teacher guidance identify and solve vital problems Problem solving skills are useful in all academic areas, as well as in the societal arena Behaviorism, humanism, the structure of knowledge, and stimulus-response learning may be emphasised within the framework of problem solving situations Subject matter in science may then be utilized in the problem solving science curriculum.

REFERENCES

ALSTON, WILLIAM P , and RICHARD W. BRANDT, 1978 *The Problems of Philosophy*, third edition. Boston : Allyn and Bacon. inc., pages 257-258

BIGGE, MORRIS, 1982 *Educational Philosophies for Teachers* Columbus, Ohio Charles E. Merrill Publishing Company, pages 25-26

BLANCHARD, BRAND, 1964 *The Nature of Thought* New York Humanities Press, 492-517.

BRUNER, JEROME, 1968 *Toward a Theory of Instruction*. Cambridge, Massachusetts. Harvard University Press.

Combs, Arthur, 1972 *Educational Objectives Beyond Behavioral Objectives* Washington, DC. Association for Supervision and Curriculum Development

Dewey, John, 1915. *School and Society* Chicago University of Chicago Press

Ediger, Marlow, 1955. Demonstration Teaching in the Schools Education, *114*, 371-372

Ediger, Marlow, 1994 Mathematics, Problem Solving, and the Young Learner *The Primary Teacher, 19*, 34-37.

Ediger, Marlow Early Field Experiences in Teacher Education *College Student Journal 28*, 302-306

Ediger, Marlow, and D Bhaskara Rao *Science Curriculum*. New Delhi, India: Discovery Publishing House, page 117.

Edmonds, Ron, 1982. Programs of School Improvement: An Overview *Educational Leadership* December, Volume 4.

Geiger, George, W, 1955 An Experimentalist Approach to Education, *Modern Philosophies and Education* Chicago, Illinois National Society for the Study of Education, 54, 137-174

Horne, Herman Harrell, 1932 *The Democratic Philosophy of Education*. New York The Macmillan Company, 325-340

Mager, Robert F., 1972 *Goal Analysis*. Belmont, California. Fearon Publishers

Missouri Department of Elementary and Secondary Education, 1996 *Show Me Standards*, Jefferson City, Missouri

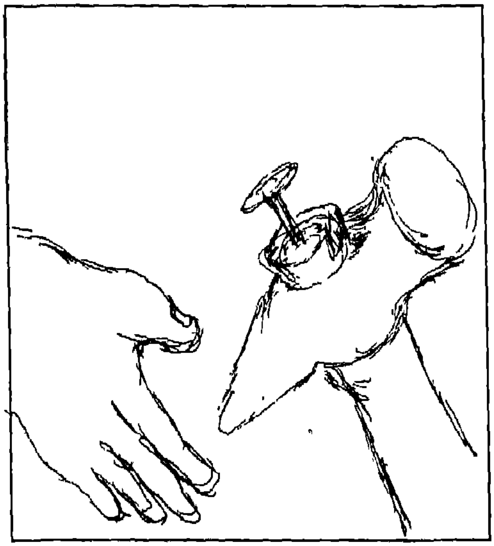
Meyer, Adolph E, 1949. *The Development of Education in the Twentieth Century* Englewood Cliffs New Jersey : Prentice-Hall, Inc., pages 42-43

Skinner, B F, 1979. *Beyond Freedom and Dignity*. New York : Alfred Knopf, Inc

Tillman, Frank A., and Others, 1971 *Introductory Philosophy* New York . Harper and Row, page 550

Technical Education Awareness in Schools – A Basic Curriculum (TEACH - ABC)

B M. Gupta
Reader
Department of Educational Measurement and Evaluation
National Council of Educational Research and Training
New Delhi 110 016



Improvement in the quality of science and technology education has been one of the major concerns of the educational, administrative and political leaderships in all the countries of the world Every day new principles, materials and devices are discovered and being made use of in bringing out new gadgets and instruments to help the population in performing their tasks at homes and work places more efficiently and economically. Besides this, the world of twenty-first century will be more technologically oriented than the world of today We know that knowledge is growing exponentially and more than doubling in volume in a decade The pace of development in the fields of science and technology will be much more in the years to come. Hence, in this age of fast changing and developing technologies it has now become necessary for all the countries, especially developing countries like ours, to reorganize and improve the curricula in education inclusive of general education as well as that of science and technology education at school level. Since time available for formal education in schools is limited, as compared to the knowledge to be imparted, it may also be required to improvise and reform mechanisms of transactions and teaching methods

Present Status of Science Education

We find that a system of education has come to stay which gives more importance to 'learning from books' and thus there are few teachers who make full and effective use of other printed materials, laboratory equipment and the environment in imparting instructions to children Time and society need citizens who are socially productive and use their education and training through better use of materials and manual activities so that the life can be more enjoyable and be more rewarding at workplaces and homes

In our school curriculum we have taken care to include 'Social Studies, Mathematics and Science' as a part of general education besides languages and socially useful productive work However, technical activities involving manual skills hardly had a place in the curriculum. This is an area which needs serious consideration to meet the challenges and demands of the future society

The need for improving science education in the country had been felt since the sixties and several efforts have been made to improve the teaching of science at school level. But the efforts have been mainly concentrated towards improvements in textbooks, revision of syllabi, strengthening of laboratory and library facilities, short-term in-service and refresher training and enrichment courses and orientation of teachers. However, science curriculum needs to be dynamic enough to keep pace with the developments in the field of science and technology. The content of course, therefore needs to be updated continuously to meet the new demands Science and technology have tremendous impact on the society This needs to be reflected in our curriculum. Concept of science becomes applicable through technology. Till science is applied through technological products it remains "bookish" looked up in laboratories and cupboards only as a principle or a resource for "thinking" but it needs to be a resource for 'doing'.

To make science teaching participatory and activity based in our country, UNESCO has provided assistance in the form of import of equipment, experts and financial support to establish curriculum and equipment development centres It stressed on a practical approach for the design, development and mass production of equipment from locally available inexpensive materials as well as waste materials such as pins, bottles, old tins In India, the National Council of Educational Research and Training, New Delhi provided leadership and developed a number of science kits for teaching science at primary and middle school levels of education At secondary level, electronics kits have also been developed But coming to realities to exploit this approach was easier on paper than on the shopfloor unless one is equipped with a good workshop facilities. Because considerable scientific insight, technology support and practical skills are required to translate the ideas in the form of equipment, Only expert teachers with enough experience with hand-tools can succeed in such ventures Secondly, the teachers teaching in secondary schools have been 'brought up and trained' on pure science background and often lack the skill and ability to fabricate equipment on their own from locally available, inexpensive and waste materials It is like making a receipt from a 'cookery book' without actually having made one earlier.

We are heading for science and technology based society and curriculum in schools has been changing continuously It is hoped that science teaching is really going to benefit the population not only in solving their problems of daily-life but also to cope with rapidly changing technologies at work places and at homes. In this age of science and technology most of us would be called upon to preserve, maintain and repair our own houses, furniture, electromechanical toys, electrical, mechanical and electronics gadgets which are becoming essential parts of our day-to-day life. Many of these items could be easily repaired and maintained by us To do so, we need not become skilled craftsmen What is actually needed is a basic technical knowledge, ability and skill besides some exposure and 'hands on' experience Really speaking, without an early age exposure many of us develop an emotional barrier, status consciousness or false pride and an attitude for not getting 'our hands dirty'. It is this attitude which forbids our learning and training in this field. It is this barrier which needs to be broken This requires an in-built mechanism in school curriculum that may provide enough scope to impart basic skills to initiate action to solve some of the household problems mentioned above besides developing proper attitude to undertake such an exercise This objective can be achieved to some extent by making development of technical skills an essential component of school curriculum.

Introduction of Technical Education Awareness in Schools — A Basic Curriculum ("TEACH-ABC") may prove to be helpful in this regard.; The basic purpose of the proposed curriculum is not to impart the skills of a carpenter, plumber, mechanic, electrician, painter or similar other trades but to make the students appreciate dignity of labour and in the process acquire certain skills which may be useful in everyday life It is envisaged that TEACH-ABC will be valuable particularly for future executives and managers as they will be called upon to assess the feasibility of industrial projects and would need more than a textbook knowledge of problems likely to be faced. At present science teaching is oriented towards either verifying already known experimental results or demand 'the exact' explanation. But unfortunately, the real-life situations and problems require an entirely different approach in which various alternative solutions of a problem need to be considered 'Ideal' or 'Right' solutions have to be considered against economic ones which include material, labour and time factors besides their impact on society Perhaps there is a need to change the culture of science education from 'reading about Science' to 'performing with science' through manual activities Hence science education needs to be practice-oriented through the integration of Technical Education Awareness in Schools

Rationale for Relating Technology to Science Education

It is through science that we get the fundamental knowledge to develop technology and use it for betterment of mankind The present day children are far more informed because of their exposure to an enriched environment as compared to the previous generation They have grown with and used a variety of products of technology in the form of radio, television, telephone, mobile phone, pager, photocopier, motor car, bicycle, sewing machine, electric iron, electric, fan, furniture, calculator, digital and analog watches etc Although children take these gadgets and things as a matter of fact yet they are keen to know and learn about their design, construction, principle of working and operation besides being curious about the materials, process and tools they are made up of. Children also observe that wires used in connecting an electric heater, a telephone instrument, a pole or an antenna with a television are different They also observe that the furniture items in homes and at schools are usually painted and varnished once in a year or two They see how a mechanic removes a rusty nut and lubricates the moving parts in a bicycle or a sewing machine to enable its smooth operation i.e greater efficiency Many children often their show eagerness to make and repair things of daily use with their own hands. Are our children sufficiently equipped in knowledge and skill to face and accept this challenge? Perhaps, they are neither adequately trained nor exposed to such things But we can't afford to sit back and watch, perhaps introduction of Technical Education Awareness in Schools—A Basic Curriculum" (TEACH-ABC) as an integral part of school education may provide answers to some of these questions What should it contain? Where is it to be introduced?

What should be its status in curriculum? How should it be taught? What about teachers and physical facilities? Whether "TEACH-ABC' may form a part of science education, socially useful productive work or combination of these These are some of the many issues involved that need to be considered.

Aims and Objectives

TEACH-ABC Course should be developed on the basis of the following aims and objectives

1 To provide students with basic knowledge, experiences and skills with hand tools, materials, processes and technology to equip them to tackle simple problems in daily life at homes and workplaces
2 To develop confidence in making use of variety of things and gadgets and to undertake their maintenance and repairs by exposing students to situations and problems where they try to find what will make them work? What could be the fault if they do not work? What will make them work and how to upkeep them?
3 To make them aware and provide experience with various types of uses of oils, paints, varnishes and lubricants These may include their use for maintenance, preservation and improvement of wooden, metal or plastic surfaces; removal of stains and spots, removal of rusted nuts, simple mechanical devices such as bicycles, sewing machines, hand or animal driven carts, agricultural implements, automobiles etc.
4. To equip them with basic skills desirable for making mechanical joints and undertaking repairs of things made up of wood, metals, plastics and rubber. This will provide them basic understanding and experience to take up jobs requiring joints, soldering, welding and use of adhesives
5 To make them aware of the properties of various materials, different types of woods used in furniture and

at home, metals and alloys used in making kitchen wardrobes and in the construction of houses, plastics and rubbers used in homes, and in industries

6. To make them aware of the fact that the connecting chords used for different purposes such as for television aerial, table lamps, electric heater, telephone instrument, microphone and overhead lines differ in their materials and design and also to appreciate the reasons for choosing different ratings of fuses for different purposes.
7. To expose the children to alternatives for different metals for day-to-day use and reason out why particular shape, size and material has been used through examples. Why are rivettes made up of aluminium? Why brass has been chosen for electrical plugs and pins? Is it essential to use copper coating for electrical wires and plastic or rubber for covering them?
8. To help them draw analogy between domestic electrical circuits and water supply system At the same time making them aware of the hazards associated with careless handling of electrical lines and gadgets This should, however always be borne in mind that the exposure of children with various technical skills should not be construed to provide the knowledge and skills equivalent to that of a professionally skilled worker like that of a carpenter, plumber, electrician, painter or mechanic. The main objective of the purposed curriculum is to encourage a positive attitude and approach towards dignity of labour. The course should aim to inculcate a practical problem-solving approach in children This should not be restricted only to the identification and spelling out the use of components and materials but should have 'hands on' experiences as an integrated and essential component It is envisaged that this concept will not only help in improving teaching/learning process but would also play an important role in enhancing understanding of basic concepts of science and would be an essential requirement in the liberalized and globalized environment

Teachers for Teaching "TEACH-ABC"

The role of teachers is pivotal in spreading and making the concept of technical education such as TEACH-ABC acceptable through the 'right selection' and the 'right use' of materials and selection of appropriate practical situations and problems Highly competent and skilled technical personnel are always in great demand and have a high employment potential in industry business and trade It may, therefore, be difficult to engage a large number of highly technical qualified personnel as teachers. Secondly appointing additional personnel may also have financial implications which itself may prove to be an impeding factor for the success of technical education Science teachers with proper orientation and training may bridge gap We could even make certain changes in the curriculum of pre-service training of science teachers to make room for technical knowledge and skills. Some institutions in the country (e g. Regional Institutes of Education under NCERT, New Delhi) have in the past made some efforts in this direction. Four-year courses leading to Bachelor of Science Education conducted by Regional Colleges of Education (now RIE) in seventies These institutes can provide direction and leadership in this field. Once technology finds a place in science curricula, future generation of students and, obviously of science teachers that will have a background of technical knowledge, competence and skills will be available. Another factor which may facilitate this trend is the overall industrial development, resulting in ever increasing number of household gadgets and equipment Their use is expected to generate a demand for education, awareness, and experience about the technology involved in their usage, maintenance and repairs Thirdly, the non-availability and increased cost of even minor repairs and maintenance will encourage and force individuals to acquire technological competence and skills Through training, science teachers will be able to acquire enough competence and skills in technology required to teach and conduct courses sufficient to impart basic knowledge and skills rather than producing skilled craftsmen and facilities.

Material and Facilities for Teaching "TEACH-ABC"

For introducing technology course we need some equipment and materials but to provide lavish workshops which would become a museum of instruments and machines is not the thing we are aiming at. If we provide sophisticated and costly equipment and materials the teachers would never use them instead will keep them stored and locked up for the fear of being held responsible for any loss or breakage. Secondly, the facilities for repairs of sophisticated and expensive equipment is available only at a very selected places and big cities and requires highly skilled technicians besides costing unaffordable sums of money However, we can develop some kits such as hardware kit, electrical kit, hand tool kit and materials kit The actual component of these kits will depend upon the curriculum

Evaluation

The major objective of the proposed technology course is to provide experiences and effective use of tools, technology, processes and materials through their applications in daily life situations and problems. Whether the objectives have really been achieved depends to a large extent on the methods of evaluation used. Since the contents of technology course is practice-oriented, its evaluation has to be through a different method than the traditional paper pencil tests. The most suitable method of evaluation perhaps would be to stress on finding solutions for day-to-day real life problems and situations through laboratory exercises If this is not possible for some reasons and we are required to follow the prevalent traditional mode of "written" examinations then the emphasis of questions should be on to assess whether practical exercises during teaching/learning process have provided enough scope to develop effective use of materials and tools.

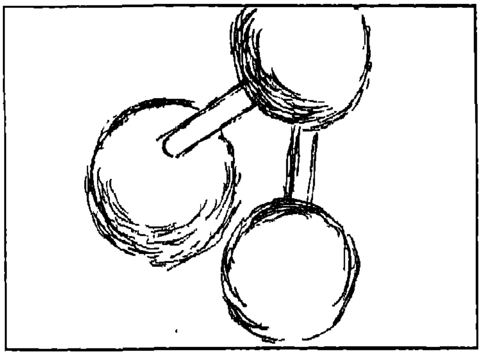
Conclusions

The issues concerning introduction of Technical Education Awareness in Schools for students of secondary stage need to be carefully examined. In order to arrive at plausible solutions for wider implementation a pilot study may be undertaken to making use of existing science laboratories through minimal addition of staff and equipment, of course, the teachers have to be trained and tuned for a practical-oriented problem-solving approach. Since existing textbooks or materials may not cover all aspects of the proposed course, a group comprising of curriculum developers, equipment designers and science teachers could develop a comprehensive plan of action for the programme of technology instruction including list of learning situations, materials, laboratory equipment, textual material to support, manual of activities, tools and techniques of formative and summative evaluation and all other related aspects. Based on the experiences and findings of the suggested pilot study a curriculum on technology education may be developed for wider implementation.

A Diagnostic Study of the Common Errors Committed by Students in Writing and Solving of Chemical Equations

S Paul Douglas
Lecturer
Fatima College of Education
Warangal 506004 (A P)

G Sundara Rao
Lecturer
A.L. College of Education
Guntur 522002 (A P.)



When properly taught to a high school student, chemistry is a powerful aid towards getting him to think in logical and organised way To make high school chemistry merely descriptive is fully as fatal as to restrict it discussions of atoms, molecules and various questionable theories connected to them A high school course in chemistry should endear the study of natural phenomena to the student and lead him to see the important relationships between the chemical changes and the other phenomena of our every day existence" (Prof Louis Kehlemberg, 1914)

Chemistry is the study of the properties, the composition and the structure of matter, the changes that occur in matter and energy that is released or absorbed during these changes Chemistry, like all the natural sciences is an experimental science The general aim of chemistry is to discover everything possible about all the characteristics of matter.

Teaching of chemistry at higher secondary level is a major change from the traditional learning in India Basic chemical concepts are developed in the beginning and applied to the study of elements and their compounds in the latter units. The chemical facts to be taught should be presented in the order of difficulty of comprehension rather than in strict logical order

Teaching chemical equations which are special forms of communication in chemistry, requires a thorough knowledge Since chemical equations are the most important concepts in chemistry which can be used from the school laboratory to the research in universities and chemical laboratories, knowledge of these chemical equations is a must for every student studying chemistry. The stage at which symbols, formulae and equations are introduced into school varies widely

Chemical equations are representation of reactions in terms of the symbol and formulae of the elements and compounds involved Chemical equations report the results of experimentation. One of the goals of chemistry is the discovery and development of principles that make it possible to predict the products of chemical reactions.

Need for the Study

For any subject, basic fundamentals, fundamental concepts and principles are the basic units of that particular subject which are essential to know, study, learn and master that subject. For learning chemistry the basic fundamental knowledge of atoms, molecules, atomic structure, chemical bonding, periodic table, symbols of elements, formulae of compounds, chemical equations, etc , are the most fundamental things that are essential to pursue the study of chemistry.

The high school students of Andhra Pradesh state are exposed to the knowledge of chemical equations from Class 6 to Class 10 (high school) level. When a student finds it difficult to proceed forward in the set/prescribed direction in learning the subject of chemistry, it is obvious and natural that there must be some difficult aspects that the student has not able to understand properly, the way it should be, and ultimately begins and continues to commit errors in those felt difficult aspects.

The present study is basically a diagnostic study intended to diagnose and identify the relatively difficult aspects of 'writing and solving of chemical equations'. This diagnostic study can help to suggest modifications to the existing curriculum and prevailing practices of the teaching-learning processes with regard Classes to 9,10, and the junior intermediate chemistry

Focus of the Study

The focus of the present study is to diagnose and identify the common errors committed by students in writing and solving chemical equations and the areas in which the students are strong and weak and the level of attainment of the concept in different classes

Objectives of the Study

1. To identify the common errors committed by students of Classes 9,10 and junior intermediate in writing and solving of chemical equations.
2. To list out the areas in which the students are weak and strong.
3. To analyze the nature of errors
4. To compare the common areas in which the students commit more mistakes,
5 To compare the significant difference in the performances of students class-wise in different areas.

Review of Related Literature

Research literature regarding 'diagnostic studies' in physical sciences concerning school children in Indian schools is very limited. Comparatively less amount of work is reported regarding physical sciences and on its teaching especially chemistry

Bountra, R.K. (1970) constructed and standardized an achievement test in physical science (physics and chemistry) for high school classes in

Uttar Pradesh.

Adinarayana, V (1976) studied the conceptual development in chemistry among the intermediate students by using a diagnostic test

Durgarani, Ch. (1981) studied the conceptual attainments in chemistry among 8th class children.

Pachaury, A C., (1990) studied balancing chemical equations by high school and college students and pre-service science teachers

Tool

From the review of related literature, the previous investigations and from the objectives of the study the investigator felt that a diagnostic test will serve the purpose of the investigation. A test was constructed to diagnose and identify common errors committed by students in the following ten areas in which a student is expected to show proficiency so that he can properly write and solve chemical equations.

1. Identifying the symbol of an element
2. Identifying the name from its symbol
3. Identifying the groups and periods of elements in the periodic table.
4 Identifying the reactivity of elements
5 Identifying the formulae of compounds
6 Identifying the names of compounds from the given formulae.
7 Identifying the reactivity of elements
8. Balancing the given unbalanced chemical equation
9 Representing chemical reactions in terms of balanced chemical equations
10. Representing chemical equations in descriptive form.

Five suitable test items were constructed for each area The final test form contained 50 test items, each item carrying one mark

Sample

The test was administered to 150 students from each class i e 9th class, 10th class and junior intermediate of different schools and colleges The students were selected randomly from their nominal rolls with the help of the concerned authorities. The test was administered for 60 minutes.

Scoring

Each correct response was given a score of one and a partially right, partially wrong, incorrect and incomplete response received a score of zero. The scores for each area and the total scores of each student was recorded and were tabulated for statistical analysis Item analysis was made to note the errors and identify the type of errors committed by students

Statistical Treatment of Data

Data were treated statistically in two areas. Mean standard deviation, Standard error of mean, Lowest confidence intervals were calculated. Analysis of variance (ANOVA) and 't' tests were computed for contrast pair mean differences in the achievement of students in different areas. Discrimination index values for each test item, for each class were calculated from in which the errors committed by students were classified.

Results

TABLE 1

Achievement in writing and solving of chemical equations — class wise comparison

Sample	*N*	*Mean*	*SD*	*SE*	*Lowest Confidence Interval*
9th class	50	18 62	8.0	1 13	16 4
10th class	50	24.22	7.0	0 99	22 3
Jr. Inter	50	28.26	7 21	1 02	26 3

ANOVA yielded an F value of 20.88 which is significant at 0 01 level (df 2,147). There is a significant difference among the three groups in writing and solving of chemical equations. 't' tests were run for the contrast pair differences.

Significant differences exist between the subject of 9th class and 10th class (t=3.68; df = 98; p<0 01) 10th class and junior intermediate (t=2 81; df 98;p<0.01) 9th class and junior intermediate (t=6.26; df 98; p<0.01) in writing and solving of chemical equations on the whole.

TABLE 2

F values and 't' values for contrast pairs in area 1

F=14 76 df = 2,147; p<01

Contrast pair	t	p
9th - 10th class	0.057	NS
10th - Jr. inter	4.52	.01
9th - Jr. inter	5 48	.01

In the area of identifying the symbol of an element (area 1) ANOVA yielded an F value of 14.76 which is significant at 01 level. From the 't' values of contrast pairs it is drawn that no significant differences exist between 9th and 10th class. But significant difference exist between 10th and Jr inter and 9th and junior inter in this area

TABLE 3

F values and 't' values for contrast pairs in area 2

F=3.44, df = 2,147, p<.05

Contrast pair	t	p
9th - 10th class	1.42	NS
10th - Jr inter	1.08	NS
9th - Jr inter	2.70	01

In the area of identifying the name of given symbol of an element (area 2) ANOVA yielded an F value of 3 44 which is significant at .05 level. From the 't' values of contrast pairs it is drawn that no significant difference exist between 9th - 10th classes and 10th-junior intermediate. But a significant difference exist between 9th junior intermediate in this area.

TABLE 4

F values and 't' values for contrast pairs in area 3

F=18 15; df = 2,147; p<..01

Contrast pair	t	p
9th - 10th class	3 99	01
10th - Jr. inter	1.93	NS
9th - Jr. inter	5 12	01

In the area of identifying the group and period of an element (area 3) ANOVA yielded an F value of 18 15 which is significant at 01 level. From the 't' values of contrast pairs it is drawn that significant differences exist between 9th class-10th class and 9th class-junior intermediate but there is no significant difference exists between 10th class-junior intermediate in this area.

TABLE 5

F values and 't' values for contrast pairs in area 4

F=11 83, df = 2,147, p< 01

Contrast pair	t	p
9th - 10th class	2.68	.01
10th - Jr inter	2.51	.05
9th - Jr. inter	4 38	01

In the area of identifying the reactivity of elements (area 4) ANOVA yielded an F value of 11.83 which is significant at 01 level From the 't' values of contrast pairs it is drawn that there exist a significant difference between the contrast pairs in this area

TABLE 6

F values and 't' values for contrast pairs in area 5

F=1 92; df = 2,147; p<.05

In the area of identifying the formula of a compound (area 5) ANOVA yielded an F value of 1.92 which is insignificant at 05 level. Hence there is no mean difference among the three groups in this area

TABLE 7

F values and 't' values for contrast pairs in area 6

F=26 09 , df = 2,147, p< 01

Contrast pair	t	p
9th - 10th class	0 4	NS
10th - Jr inter	5 66	.01
9th - Jr. inter	5.98	.01

In the area of identifying the name of a given formula of a compound (area 6) ANOVA yielded an F value of 26.09 which is significant at 01 level. From the 't' values of contrast pairs it is drawn that no significant difference exists between 9th-10th classes and there is a significant difference between 10th class-junior intermediate and 9th class-junior intermediate in this area

TABLE 8

F values and 't' values for contrast pairs in area 7

F=3.3 , df = 2,147, p<.05

Contrast pair	t	p
9th - 10th class	2 54	0 05
10th - Jr. inter	1.14	NS
9th - Jr. inter	1.43	NS

In the area of identifying the reactivity of the reactants (area 7) ANOVA yielded an F value of 3 3 which is significant at .05 level From the 't' values of contrast pairs it is drawn that significant difference exists between 9th class-10th class But there is no significant difference between the other groups

TABLE 9

F values and 't' values for contrast pairs in area 8

F=7 93 ; df = 2,147; p< 01

Contrast pair	t	p
9th - 10th class	2 21	.05
10th - Jr inter	1 82	NS
9th - Jr inter	3 94	01

In the area of balancing the equations (area 8) ANOVA yields an F value of 7.93 which is significant at 01 level.

From the 't' values of contrast pairs it is drawn that no significant difference exist between 10th class-junior intermediate but significant differences exist between the remaining groups.

TABLE 10

F values and 't' values for contrast pairs in area 9

F=8.65 , df = 2,147, p< 01

Contrast pair	t	p
9th - 10th class	2 22	05
10th - Jr. inter	1.05	NS
9th - Jr. inter	3 59	.01

In the area of representing a chemical reaction in terms of an equation (area 9) ANOVA yields an F value of 8.65 which is significant at .01 level. From the 't' values of contrast pairs it is drawn that no significant difference exists between 10th class-junior intermediate but significant differences exist between the other groups.

TABLE 11

F values and 't' values for contrast pairs in area 10

F=6.41; df = 2,147; p< 01

Contrast pair	t	p
9th - 10th class	2 84	.01
10th - Jr. inter	0.28	NS
9th - Jr. inter	3 18	.01

In the area of representing a chemical equation in descriptive form (area 10) ANOVA yielded an F value of 6.41 which is significant at .01 level From the 't' values of contrast pairs it is drawn that no significant difference exists between 10th class-junior intermediate but significant differences exist between the other groups.

Classification of Errors

For analyzing the type of error, any test item which is correctly answered by 70% and above of the students is categorized as "Individual Error", a test item which is correctly answered by 40-69% of the sample is classified as "Conceptual Error" and a test item which is correctly answered by less than 40% of the sample and a student commits a mistake is classified as "Instructional Error".

TABLE 12

Comparative statement of the errors committed: class wise-area wise

Area	*Items*	*Errors of 9th class*	*Errors of 10th class*	*Errors of Jr Inter.*
1	5	A-4 B-1	A-4 B-1	A-5
2	5	A-5	A-5	A-5
3	5	A-1 C-4	B-4 C-1	A-2 B-3
4	5	A-1 B-1 C-3	A-2 C-3	B-4 C-1
5	5	A-1 B-1 C-3	A-1 B-1 C-3	A 1 B-1 C-3
6	5	B-1 C-4	B-1 C-4	A-1 B-4
7	5	B-1 C-4	B-3 C-2	B-3 C-2
8	5	C-5	B-2 C-3	B-4 C-1
9	5	C-5	B-2 C-3	B-2 C-3
10	5	B-2 C-3	B-4 C-1	B-4 C-1

A Individual Error, B: Conceptual Error
C· Instructional Error

A high percentage of errors committed by the 9th class students was classified as instructional errors, mostly in the areas of balancing the equations, writing an equation for a reaction and description of an equation. A less percentage of conceptual errors was classified in the other areas than translating elements and compounds to their symbolic forms as most of them were individual errors.

When the errors committed by the 10th class students were classified they committed an equal proportion of all types of errors Most of the individual errors committed by them were related to the ability of translating elements and compounds to their symbolic forms. Most of the instructional errors have occurred in their ability to balance an equation, writing an equation for a reaction and description of an equation. Conceptual errors were classified in the rest of the areas like periodicity, reactivity of reactants and elements.

A high percentage of errors in junior intermediate students was classified as conceptual errors in the areas of periodicity of elements, reactivity of elements and reacts, ability to balance an equation, writing an equation for a reaction and description of an equation, Individual errors were committed in the areas of translating elements and compounds into their symbolic forms.

Errors Committed

The common errors identified were·

- ☐ They committed mistakes in recognizing the symbol of an element mostly when the 'Latin' symbols were given and similarly they found it difficult to write the names of the elements when symbols were given,
- ☐ They failed to recognize the groups of elements and periods in the periodic table of elements.
- ☐ They committed mistakes in identifying the reactivity of different elements.
- ☐ They committed mistakes in recognizing the formulae of compounds when similar formulae were given and failed to write the names of compounds of formulae when similar names were given
- ☐ They committed mistakes in recognizing the reactivity of compounds when given in the form of a reaction
- ☐ They failed to recognize the reason for the reactivity of different elements even though they recognized the reactivity
- ☐ They committed mistakes in balancing the equations. They balanced the equations by changing the fomulae of reactants and products, They balanced the chemical equations without fulfilling the law of mass action/law of conservation of mass
- ☐ In writing the equations for reactions they failed to represent the formulae of reactants and products correctly in different cases
- ☐ They committed mistakes in representing an equation in words They failed to write the names of reactants and products correctly.

Discussion

This diagnostic study leads to the conclusion that the students of chemistry in high schools and junior intermediate do not possess the necessary skills and appropriate knowledge of chemistry. In view of the above the mistakes committed by them, the following suggestions are made to improve upon the basic skills in students in this area·

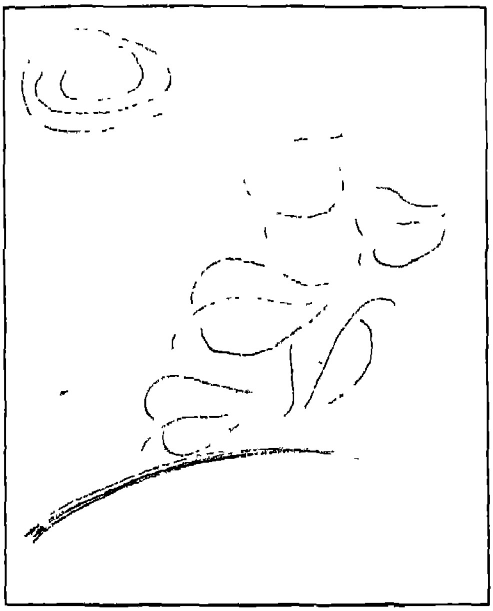
1. The students should be made to acquire a thorough knowledge of the periodic table.
2. The chemical symbols and formulae should be taught. These are better learned by drilling, quiz programmes and other play-way methods
3. The 'law of conservation of mass' and its importance in balancing equations should be taught/as a concept
4. An analysis of the textbooks also showed that the students are not introduced to the idea of writing correct equations in a systematic manner
5. The modern chemical concepts of electronic configuration, ionization, electronegativity, etc., should be taught thoroughly
6. The opinion of the experts indicates that memorization of basic information coupled with intensive practice develop the skill of writing and solving chemical equations.

REFERENCES

1. ANDREWS, DONALD H. and RICHARD J. KOKES, 1969. *Fundamental Chemistry* New Delhi, Wiley Eastern Pvt, Ltd.
2. BUCH M.B. *Survey of Research in Education* Baroda, Society for Educational Research and Development
3. DOUGLAS, S PAUL, 1991. Diagnostic study of the common errors committed by students in writing and solving of chemical equations. M.Ed Dissertation, Nagarjuna University
4. GARDNER, M.H., 1973. Inter *Disciplinary Approach to Chemistry* London
5. GARRETTE, HENRY E. 1966. *Statistics in Psychology and Education*, New York, David Mckay Company.
6. HUSEN, TORSTEN and T NE VILLE POSTLE THWAIT Ed, 1985 The International *Encyclopaedia of Education*, vol II.
7. MARTIMER, CHARLES E , 1967. *Chemistry, A Conceptual Approach*, New York, Reinhold Publishing Company
8. NEWBURY, N F , 1963. *The teaching of Chemistry in Tropical Secondary Schools.* London, Oxford University Press
9. PACHAURY, A.C., 1990. Balancing Chemical Equations by high school and college students and pre-service science teachers. *School Science* Vol XXVIII No. 3, pp 15-20
10. PIERCE, CONWAY. And R. NELSON SMITH, 1958. *General Chemistry Work Book.* Sanfransisco, W.F. Freeman & Company.
11. TWISS, GEORGE RANSOM, 1983. *Principles of Science Teaching* New York, The Macmillan Company
12. WARD, CHRISTINE, 1981. *Preparing and Using Objective Questions.* Chaltanham, Stanley Thornes Publishers Ltd

Jumping to the Conclusion May Mislead

Bashir Ahmad
Lecturer
Government College, Tral
Kashmir 192123



Consider a person going to a shopkeeper with the intention to buy almonds He satisfies himself regarding their quality/sweetness by tasting two or three almonds and then asks the shopkeeper to weigh the required quantity for him. However, during the actual consumption subsequently, he finds out a number of bitter almonds. Why is it so? The reason is quite simple that the tasting of some almonds does not guarantee the sweetness of the entire lot.

In mathematics also, we come across a number of such situations where we can't jump to a conclusion even after observing a sufficient number of similar cases. Let us recall that a number p is said to be a 'prime' if its only divisors are 1 and p Next, consider $a_n = n^2-n+41$, where $n \geq 0$ is an integer. It is easy to see that for n=0, 1,2, .a_n, is a prime Can we conclude that a_n is prime for all values of n? Certainly not, because for n=41, our conclusion does not hold good, because then $a_n = 41 \times 41$, which is not a prime.

In this article, two problems of this nature are discussed In problem (1) the conclusion fails and in (2) it holds not from the beginning, but after a certain stage

We recall that the binomial coefficient C(n,k) is defined for all positive integers n by the relation

$$C(n,k) = \frac{n!}{(n-k)!\,k!}, \quad n \geq k \geq 0,$$

0! taken as 1

$$= 0, \quad n<k$$

e g

$$C(4,0) = \frac{4!}{4!\,0!} = 1, \quad C(4,1) = \frac{4!}{3!\,1!} = 4,$$

$$C(4,2) = \frac{4!}{2!\,2!} = 6, \quad C(4,3) = \frac{4!}{1!\,3!} = 4,$$

$$C(4,4) = \frac{4!}{0!\,4!} = 1, \quad C(4,5) = 0$$

Problem (1)

Let $a_r = \sum_{k=0}^{n} (-1)^k C(n,k)K^r$, r=0,1,2,...

To evaluate a_r, say for n=4, we have,

$$a_0 = \sum_{k=0}^{4}(-1)^k\, C(4,k) \qquad (k^0=1)$$

$$= C(4,0)-C(4,1)+C(4,2)-C(4,3)+C(4,4)$$

$$= 1-4+6-4+1 = 0$$

$$a_1 = \sum_{k=0}^{4}(-1)^k\, C(4,k)k$$

$$= 0 - C(4,1)\,1 + C(4,2).2 - C(4,3).3 + C(4,4).4$$

$$= -4 + 12 - 12 + 4 = 0$$

$$a_2 = \sum_{k=0}^{4}(-1)^k\, C(4,k)k^2$$

$$= 0 - C(4,1)\,1^2 + C(4,2).2^2 - C(4,3).3^2 + C(4,4).4^2$$

$$= -4 + 24 - 36 + 16 = 0$$

$$a_3 = \sum_{k=0}^{4}(-1)^k\, C(4,k)k^3$$

$$= 0 - C(4,1)\,1^3 + C(4,2)\,2^3 - C(4,3).3^3 + C(4,4)\,4^3$$

$$= -4 + 48 - 108 + 64 = 0$$

These observations lead to the conclusion that $a_r = 0$ for all values of r

But $a_4 = \sum_{k=0}^{4}(-1)^k\, C(4,k)k^4$

$$= 0 - C(4,1).1^4 + C(4,2).2^4 - C(4,3).3^4 + C(4,4).4^4$$

$$= -4 + 96 - 324 + 256 = 24 \neq 0$$

In fact none of a_5, a_6,.. vanish.

Problem (2)

Let $a_k = \sum_{m=r}^{n} C(m,k)$, r,k = 0,1,2,..

For the particular values, n=5, r=3, we have,

$$a_3 = \sum_{m=3}^{5} C(m,3)$$

$$= C(3,3) + C(4,3) + C(5,3)$$

$$= 1+4+10 = 15$$

$$= C(6,4) = C(5+1,3+1).$$

$$a_4 = \sum_{m=3}^{5} C(m,4)$$

$$= C(3,4) + C(4,4) + C(5,4)$$

$$= 0+1+5 = 6$$

$$= C(6,5) = C(5+1,4+1).$$

$$a_5 = \sum_{m=3}^{5} C(m,5)$$

$$= C(3,5) + C(4,5) + C(5,5)$$

$$= 0+0+1 = 1$$

$$= C(6,6) = C(5+1,5+1)$$

The pattern followed in a_3, a_4, a_5, leads us to write

$$a_2 = C(5+1,\ 2+1) = C(6,3) \text{ and}$$

$$a_1 = C(5+1,\ 1+1) = C(6,2)$$

But $a_2 = \sum_{m=3}^{5} C(m,2)$

$$= C(3,2)+C(4,2)+C(5,2)$$

$$= 3+6+10=19 \neq C(6,3)$$

$$a_1 = \sum_{m=3}^{5} C(m,1)$$

$$= C(3,1) + C(4,1) + C(5,1)$$

$$= 3+4+5 = 12 \neq C(6,2)$$

Let us now study the cause regarding the failure of conclusion in these two problems.

By using the results from differential calculus, the following information regarding (1) is obtained

$$a_r = 0, r = 0,1,2,\ldots,n-1$$

$$= (-1)^n n!,\ r = n$$

$$= (-1)^n (n+1)!\ n/2,\ r = n+1$$

The proof which is a bit difficult to be presented here explains clearly why $a_n \neq 0$, even though $a_0, a_1, \ldots, a_{n-1}$ are all zero

Another explanation is provided by taking the set theoretic approach to this problem:

Let A and B be two non-empty sets having the number of elements r and n, respectively A mapping F from A into B is said to be onto if the range of F is B The number of such mappings is

$$(-1)^n \sum_{k=1}^{n} (-1)^k C(n,k)\ k^r,\ (1,p23)$$

$$= (-1)^n \sum_{k=0}^{n} (-1)^k C(n,k)\, k^r, = (-1)^n a_r$$

and it is obvious that there is no onto mapping from A to B if r<n However, if r≥n, such mappings will always exist

For the Problem (2), we use the relation

$$\text{(I)}\quad C(r,r) + C(r+1,r) + \dots + C(n,r) = C(n+1,r+1) \qquad [2, \text{p62-63}]$$

Now $a_k = \sum_{m=1}^{n} C(m,k)$

for K=r,

$$a_k = \sum_{m=r}^{n} C(m,r) = C(n+1,r+1), \text{ from (I)}$$
$$= C(n+1, K+1)$$

for k>r,

$$a_k = \sum_{m=r}^{k-1} C(m,k) + \sum_{m=k}^{n} C(m,k)$$
$$= \sum_{m=k}^{n} C(m,k),\ C(m,k) = 0,\ k>m$$
$$= C(n+1, k+1), \text{ from (I)}$$

for k<r,

$$a_k = \sum_{m=k}^{n} C(m,k) - \sum_{m=k}^{r-1} C(m,k)$$
$$= C(n+1,k+1) - C(r,k+1), \text{ from (I)}$$

Consequently, it explains the failure of conclusion in Problem (2).

The relation $a_k = C(n+1, k+1) - C(r, k+1)$ holds for all values of k, as for k≥r, C(r,k+1)=0. Therefore, it is a generalisation of (I).

Alternatively, we have by using the formula for the sum of a geometric series,

$$(1+x)^r + (1+x)^{r+1} + \dots + (1+x)^n = \frac{(1+x)^{n+1} - (1+x)^r}{x}$$

Equating the coefficients of x^k on both sides, we have

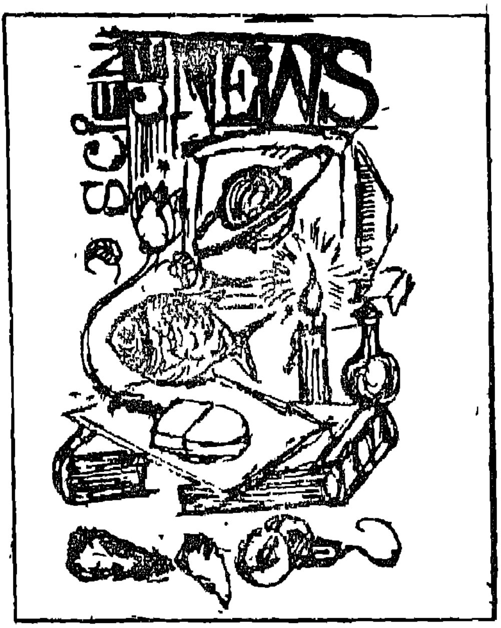
$$C(r,k) + C(r+1,k) + \dots + C(n+1,k)$$
$$= \text{Coefficient of } x^{k+1} \text{ in } (1+x)^{n+1} - (1+x)^r$$
$$= C(n+1,k+1) - C(r,k+1)$$

REFERENCES

1 Surjeet Singh and Qazi Zameeruddin, *Modern Algebra*, 7th edition, 1995, Vikas Publishing House, New Delhi.

2. Bashir Ahmad, A useful result of combination, *School Science*, Vol XXV, No. 1 March 1987, NCERT New Delhi

Science Feature



The Body Electric

Robert Dieterich

If exposure to electric and magnetic fields (EMFs) turns out to be hazardous, the risks will pose a public health problem of unprecedented scale. People encounter EMFs almost everywhere — under high-voltage lines, near common household wiring, on electric trains, even next to a coffeemaker. Everything with electric current running through it creates an electric and a magnetic field To banish those fields from homes and workplaces would be enormously costly; to do so unnecessarily would be an almost criminal waste of society's resources For that reason, in the 16 years since the first study raised the possibility of a link between power lines and childhood cancer, policy makers have lavished money and scientific talent on research aimed at determining whether EMFs—particularly the extremely low frequency 50- and 60-hertz (cycles per second) fields near high-tension power lines—pose a real threat to health

So far the results have been mixed Scientists have pursued two avenues of investigation epidemiology, which examines disease rates among exposed populations, and laboratory research, which looks for effects of EMFs in animals, tissues or cells Each approach has run into difficulties, and the big health questions remain unresolved. But evidence and ideas have begun to emerge that make a resolution of the issues conceivable, even if no answer is yet in sight

The body of epidemiological research on people with higher-than-average exposures to electromagnetic fields—those who live near power lines, for example, or who work around electrical facilities—has yielded conflicting results. Good evidence exists that EMFs can double a person's risk for leukemia or a brain tumor and there are preliminary indications of links to more prevalent afflictions such as breast cancer or Alzheimer's disease.

But even as studies become more ambitious and sophisticated, many findings remain confusing Consider, for instance, two recent studies, of utility workers, each of which examined cancer rates in workers judged to have had the highest longterm exposure to 50- or 60-hertz magnetic fields An investigation led by Gilles Theriault of MxGill

University in Montreal, Canada, determined that, compared with a control group, highly exposed workers faced a significantly higher risk of developing some kinds of leukemia. Differences in the rates of brain tumors, however, were not statistically significant. The second study, led by David Savitz of the University of North Carolina in Chapel Hill, found that highly exposed workers showed no increase in leukemia, compared with controls, but faced two and a half times the risk of brain tumors. The discrepancies could be caused by subtle differences between the studies, though Savitz himself (whose study took five years and cost $5 million) argues that—without more specific hypotheses to test—additional large, expensive studies like his probably would prove just as inconclusive.

Meanwhile, hope and funds are turning to the laboratory to determine what biological changes, if any, might result from exposure to EMFs. One promising line of investigation involves the hormone melatonin, which is normally secreted only in darkness by the pineal gland Studies in the early 1980s showed that EMF exposure can affect the pineal gland, and several studies since then have shown that EMFs can give rise to short-term effects on the nocturnal production of melatonin in laboratory animals

Steven M Yellon, a reproductive endocrinologist at Loma Linda University School of Medicine in California, has been studying how changes in daily light-dark cycles affect the production of melatonin in hamsters. Hamsters are seasonal breeders, and over the long term, varying the dark period to mimic the change of seasons can stimulate or stifle their reproductive behaviour. (The production of melatonin is lower in the summer than it is in the winter because melatonin is only produced at night) Two hours before turning the lights off, Yellon exposes some of his hamsters to 15 minutes in a 60 hertz magnetic field of one gauss (a unit of magnetic flux density). The exposed hamsters, he notes, secrete less melatonin than do those in a control group and produce it for a shorter period, suggesting that EMFs can mimic the effects of a long summer day So far, however, preliminary experiments suggest that over longer periods, EMFs do not override the effects of shorter or longer periods of light

Another line of laboratory studies on EMFs has examined one of the cornerstones of cell function. gene expression, the mechanism whereby genes are activated to create RNA (ribonucleic acid) and proteins The field gained particular notice (and some notoriety) after the developmental geneticists Reba Goodman of Columbia University and Ann S Henderson of Hunter College, both in New York City, reported in 1992 that magnetic fields can interfere with the processes that regulate the growth of human cancer cells When they placed human leukemia cells in a weak, 60-hertz magnetic field, the cells responded by quadrupling the steady-state transcript levels of the gene c-myc, which plays a critical role in tumor formation.

Since Goodman and Henderson's paper appeared, the U S Government has committed some $9 million to gene-expression studies in about a dozen labs. Many of the investigators report that EMF exposure does indeed seem to affect gene expression. But the original work by Goodman and Henderson, they say, was flawed.

Jeffrey D Saffer, a molecular chemist at Battelle Pacific Northwest Laboratories in Washington state, says he attempted to replicate Goodman and Henderson's c-myc findings and failed "It was a great disappointment", he says, At least two other labs have also been unable to repeat the work.

Saffer and others question a number of the findings of the original study, and Goodman now admits that the four-fold or greater increase she and Henderson reported earlier has not held up. But, she says, she and Henderson have spent a year working independently to repeat their experiments, and she defends her basic results She now maintains there is a consistent increase of 60 per cent in the expression of the c-myc gene after 20 minutes of exposure to a 60-hertz magnetic field "The fact is, there are changes in gene expression", she concludes, adding that her critics seem to agree

Meanwhile, at Battelle, Saffer is studying a line of mouse skin cells that have been initiated (the first step in carcinogenesis) but — in contrast to the human leukemia cells studied by Goodman and Henderson — have not been fully transformed into tumor cells A chemical known as tissue plasminogen activator (TPA), however, can push the initiated cells over the line into full-blown cancer. In initial experiments, Saffer says, it seems that one can increase the number of cells undergoing complete transformation not only by dosing the cells with TPA alone, but also by combining a "suboptimal" dose of TPA with exposure to a strong magnetic field The effect is not striking, he says, and it does not give direct information about gene expression. But it does suggest that the EMF is affecting the cells.

In the mid-1980s, Carl F Blackman of the U.S Environmental Protection Agency's Health Effects Research Laboratory in North Carolina, examined how EMFs might affect the release of calcium by brain tissues. He removed brain tissue from chicks, soaked it in a solution that included radioactive calcium, and exposed some specimens to EMFs. The tissue that had been exposed to EMFs released more calcium than did that of the controls, and the response depended on the intensity and the frequency of the exposure Surprisingly, however, the response was irregular Instead of increasing steadily with stronger fields or higher frequencies, the calcium was released only in certain windows of intensity or frequency

Those early results inspired Blackman to start a more ambitious project Working with rat tumor cells, he has shown that EMFs affect the rate at which embryonic nerve cells grow neurites, or branches, when exposed to nerve growth factor But that was only Blackman's first step with the tumor cells; the interesting problem, he says, is "exploring what really constitutes exposure"

Most experiments expose cell cultures either to a single 60-hertz alternating-current (AC) field or to a few different fields Blackman, in contrast, has subjected his rat cells to a wide-ranging menu of intensities and frequencies

He also factors in the strength and direction of the Earth's direct-current (DC) magnetic field All those conditions together determine whether an effect is present

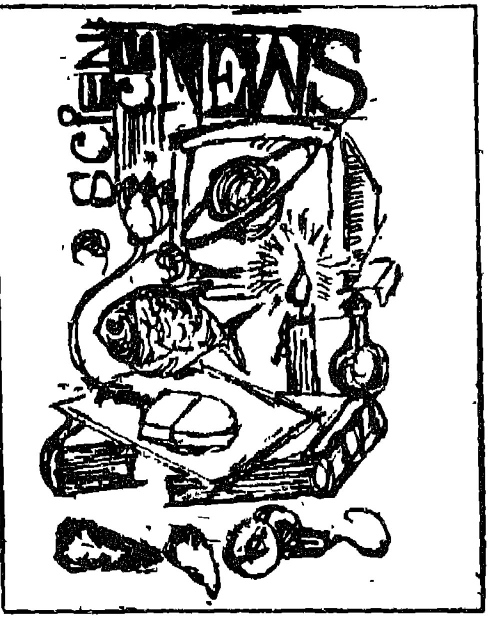
"Our image of what is happening is of ions in a cavity in an enzyme that is essential for neurite growth," he says The AC and DC fields in combination "alter the way the ion rattles around in that cavity, affecting the efficiency of the enzyme" and causing the results, he observes. Blackman and a colleague, Janie Blanchard of the Bechtel Corporation in San Francisco, named the model "ion parametric resonance "

If the model is accurate, it describes a mechanism for at least some of the observed biological effects of EMF exposure It could also explain some of the difficulties in reproducing EMF experiments It might even take a step toward explaining why epidemiology gives such inconsistent results Epidemiologists' tools for assessing exposure to electromagnetic fields are crude by any measure; faced with the subtle interplay of AC and DC fields that Blackman proposes, they would be widely inadequate

Among other EMF investigators, reactions to the resonance model range from tentative to skeptical. Blackman himself says that he welcomes criticism, in the past, he notes, champions of similar models have "tried too hard" to defend them and have thereby lost credibility But, if correct, his idea could transform the face of research into the health effects of electromagnetic fields

Courtesy . SCIENCE UPDATE

Science News



Remote Sensing Satellite Launched in Orbit by PSLV-C1

The first ever launching of an indigenously built remote sensing satellite from Indian soil with a satellite launch vehicle developed by Indian scientists took place on September 29, 1997. The event was marked with the blasting off of the four-stage Polar Satellite Launch Vehicle (PSLV C1) from Sriharikota Launching Station, carrying with it a 1200 kg remote sensing satellite (IRS-ID). About 19 minutes after the lift off, PSLV placed the IRS-ID into a polar orbit. The solar array of the satellite was deployed automatically by an on board sequencer soon after it got separated from the launch vehicle. IRS-ID is an advanced model of its predecessors which were launched by Russian Molniya rockets.

Self reliance in space technology by developing expertise required to put up an indigenously built satellite in an earth's orbit with a launch vehicle developed in the country has been one of the major objectives of the space programme of India since its inception nearly thirty-five years ago. Indian space science programme entered into a new era when it came a step closer in realizing this goal with the launching of the IRS-ID satellite. With this achievement India joins the select group of nations possessing capability to launch 1000 kg class satellites. It is envisaged that this mission would end India's dependence on other countries for launching IRS class of satellites. IRS-ID has been designed to transmit satellite imageries with 5.6 metre resolution. It is expected that the satellite data made available by the satellite will further augment its use for a variety of purposes like surveying of ground water, mineral deposits and fish culturing, monitoring weather, floods, forest development and agricultural production, wasteland development, town planning and a number of other fields. Besides it is also expected to further boost the demand from other countries for the satellite imageries obtained through IRS series of satellites.

However, IRS-ID may have to curtail some of its functions because the satellite launch vehicle has placed it in an elliptical orbit with a perigee of 300 km and an apogee of 823 km instead of a circular orbit of radius 817 km as has been planned Preliminary investigations by the scientists at the Indian Space Research Organization (ISRO), the organization responsible for planning and implementation of space programme in India, have indicated that the reason for attaining a lower height than its predetermined orbit may be due to a snag that developed in the last stage of the launch vehicle which might have caused a leak in its fuel tank although the first three stages have performed well. Scientists, how ever, were confident of correcting the orbit size by firing thrusters on board the satellite utilizing part of the 84 kg fuel provided in the spacecraft for minor correction of its orbit during its lifetime It may reduce the expected life of the satellite

Mars Pathfinder Inaugurates New Era in Space Exploration

The Mars Pathfinder, the first spacecraft to touch down on the surface of the planet Mars in 21 years, has already begun to provide the first-ever chemical analysis of what the Red Planet is made of and indications of how it may have evolved

The Pathfinder, launched in December 1996 landed on July 4, 1997 on an ancient plain called Area Vallis where geologists believe a mighty flood once swept rocks down from the planet's highlands and slopes

The Pathfinder's main cargo, a 10-kilogram, six-wheel roving vehicle called Sojourner, rolled out after the landing and began several days of remotely controlled excursions to take close-up pictures of the planet's rocks and analyze their chemical composition It is the first time a roving vehicle has explored the surface of another planet

The two Viking spacecrafts which landed on Mars in 1976 could take photos of the rocks, but couldn't make out what they were made of. The Pathfinder mission is capable of analysing what the rocks are made of

We have seen what Mars looks like from orbit and from the surface, but not until now have we had an opportunity to find out what the planet's surface stuff is made of and where the different minerals are located, said Wesson, a senior scientist at NASA.

The Sojourner rover is equipped with an Alpha Proton X-ray Spectrometer, a device that bombards a rock with radiation and identifies its composition of chemical elements by examining how the subatomic particles bounce off of them

The first rock to be examined by Sojourner, named "Barnacle Bill" by NASA scientists, was found to be unexpectedly Earth-like. The spectrometer analysis showed the rock to contain an estimated 58 per cent silicates, which implies it is one-third quartz — a substance never before found in any extraterrestrial object

Scientists said that Barnacle Bill appears to be an andesite, a kind of volcanic rock named for the Andes Mountains where it is found, and different from basalt, which they had expected the rock to be The scientists added that the high levels of silicon, which are found in andesite, indicate that the crust of Mars is much like Earth's, with lots of quartz created by repeated heating, melting and crystallizing processes occurring deep inside the planet—processes more complex than those detected before on Mars

Scientists are not sure what kind of interior processes are at work below the Martian surface, so how it manages to make quartz remains a mystery.

"Down the line we want to be able to find out if life on Mars developed along the same lines as life on Earth," said Thanasis Economou, a designer of the spectrometer at the University of Chicago. "Before that can happen, we have to learn as much as we can about Mars and figure out what kinds of samples we should bring back "

While the Pathfinder mission is not expected to answer life-on-Mars questions, it could produce critical geochemical information on where to look for answers on future missions According to scientists, definitive evidence will probably come only with the return of Mars rock samples. The first sample return mission is planned for 2005

Images of the landing site sent back by Pathfinder have convinced scientists that the area was once the site of a massive flood that occurred eons ago They reported that the pattern in which the rocks and boulders have settled, as well as other features of the landscape, provide a powerful confirmation for such a flood

Scientists add that the flood would have stretched from horizon to horizon, flowing for hundreds of kilometres and at a depth of hundreds of metres. They believe the flood occurred between 1,000 million and 3,000 million years ago-long after the planet's formative years and at a time when the temperatures were too cold for water to remain liquid for very long. If that's the case, the flood may have resulted from some kind of unusual catastrophic event that sent water gushing back to the surface from beneath the thick layer of Martian permafrost. Scientists believe liquid water may still exist deep beneath the Martian surface

Scientists believe the era when the planet was warm enough for liquid water to exist on the surface dates back to 4,500 million to 3,600 million years ago, which is the period during which life might have arisen—if it did—on Mars. The Martian meteorite discovered in Antarctica and recently reported to contain possible signs of ancient life is thought to date back to that era.

A NASA spacecraft planned for launch in early 1999 will carry a lander that will deploy probes two meters below the Martian surface to look for water, one of the ingredients necessary for life to evolve.

However, although the evidence for a warmer and wetter Mars in the distant past is substantial, some scientists still question the assumption that the many dry channels and canyons on the Martian surface were eroded by massive water floods Instead, they suggest the terrain could have been shaped by volcanoes

Other images being sent back by Pathfinder are also providing vital opportunities to learn more about the planet For example, scientists hope to use the images of a 360-metre high peak in the distance to track the haziness of the Martian atmosphere as dust storms kick up in coming months.

"If you can get an idea about the

size of the dust, you can get an idea about density, wind patterns and how opaque the atmosphere is," Wessen said "So you're using the environment and how it changes almost as a diagnostic tool for how the planet works "

Scientists said that nearer hills contain geologic formations that will help determine how the planet evolved and what forces of nature were at work on Mars

Courtesy : SCIENCE UPDATE

Fluoride Molecules Discovered in Interstellar Space

A team of astronomers from the United States and Germany, led by the astrophysicist David Neufeld of Johns Hopkins, USA has discovered trace amounts of hydrogen fluoride gas in the interstellar space. The discovery has been made possible by using a satellite launched by the European Space Agency (EPA) This discovery adds one more molecule to a list of about 100 molecules detected so far in the interstellar space. However, the discovery of hydrogen fluoride has the distinction of being the first molecule containing fluorine detected in the interstellar gas cloud It is also for the first time that a new molecule has been detected by observations at the far-infrared wavelengths

The hydrogen fluoride molecule has been detected by the astronomers within a giant cloud of gas located near the centre of the Milky Way Galaxy These observations were made with a Long Wavelength Spectrometer in March 1997 The astronomers found evidence of absorption of trace amounts of hydrogen fluoride gas while studying the far infrared region of the electromagnetic spectrum The concentration of hydrogen fluoride in the interstellar gas has been found to be one part in billion The gas cloud in which hydrogen fluoride molecules have been detected lies in the southern constellation Sagittarius which is at about 20,000 light years from the earth. This gas cloud is mainly composed of hydrogen molecules

Fluoride in very minute amounts is considered to be beneficial to human health and therefore the water supply in some countries is fluoridated. However, fluoride is considered to be a pollutant of water and its presence in excess amount in water is known to cause fluorosis In concentrated liquid form hydrogen fluoride or hydrofluoric acid is extremely corrosive and dangerous chemical It is used for itching of glass which it can dissolve

It is envisaged that this discovery would enable the scientists to study the chemistry of fluoride molecules in the frigid conditions that prevail near vacuum of the interstellar space One of the key questions which the scientists will be looking to answer is how these molecules were formed The evidence collected so far suggests that the hydrogen fluoride detected was produced by the direct with chemical reaction between fluorine atoms and hydrogen molecules Fluorine atoms are known to be the most reactive of all elements and it is, therefore, believed that they easily attack the relatively inert hydrogen molecules that are the main constituents of the interstellar space.

Hopes Rise for Drug which Makes Cancer Cells Self-Destructive

Scientists in Wales and Scotland, U.K., have announced a breakthrough discovery which could lead to a drug to cure certain types of cancer Professors David Wynford-Thomas and David Lane are developing a drug which will use the body's natural defences to encourage cancerous cells to self-destruct

They believe that an effective drug to treat cancers of the thyroid gland, breast and skin could be available in three to five years

The breakthrough announced in Oncogene magazine, will bring new hope to the 40,000 patients diagnosed as suffering from these three cancers in Britain each year The professors' hopes rest on a naturally-occurring anti-cancer gene, named p53, which exists in every cell in the human body.

p53 is normally inactive, but is triggered when DNA is damaged and induces 'suicide' in potentially cancerous cells Professor Wynford-Thomas and his team at the University of Wales College of Medicine in Cardiff have discovered that the life-saving work of p53 is blocked in thyroid tumours by a protein called mdm-2.

Mdm-2 allows the cancer cells to escape the control of p53 and grow to form a life-threatening tumour

Now the Cardiff team have found an antibody which itself blocks the action of mdm-2 to restore the function of p53.

They are now collaborating with Prof Lane of the Cancer Research Centre Cell Transformation Research Group at the University of Dundee, Scotland, who is developing a drug to imitate the antibody Professor Lane was involved in the initial discovery of p53 18 years ago.

Professor Wynford-Thomas explained: "Mdm-2 is present in normal cells, but in tumour cells there is too much of it It is not a hereditary 'gene for cancer', but something that multiplies after the tumour appears."

It is already known that the mdm-2 can be knocked out by an antibody and that this then stops the cancer cells from growing

The researchers in Dundee are developing a drug which will imitate the antibody and restore the p53's function as a tumour suppressor

It is likely that the drug will not have any of the unpleasant side-effects that are part and parcel of conventional chemotherapy

The hope is that it will stop the further growth of the tumour, and with luck kill it off altogether In the laboratory, the antibody is killing cancer cells.

The laboratory-produced antibody-developed in the United States for an unrelated purpose—cannot be used medically because it has to be injected into each individual cell, using microscopically fine needles.

Prof Lane's aim is to create a drug which can penetrate cell walls and can therefore be taken orally or by conventional injection

Prof Wynford-Thomas said: "We don't have a drug yet, but we now know what to work towards We have identified the key target in the cancer cell, which is an important step forward

"Although my recent research concentrated on thyroid cancer, we know that it has implications for breast cancer and malignant melanoma patients as the p53 in those cancers often behaves in the same way

"The downside is that this won't work for all cancers Other cancers can evade this defence mechanism in other ways that may not be amenable to treatment in this way" Professor Gordon McVie, director general of the Cancer Research Campaign, welcomed Professor Wynford-Thomas's announcement "The implications of this latest research are far-reaching as p53 is defective in at least 60 per cent of cancers."

"The discovery of p53 was an exciting step forward in our understanding of the process that turns a normal cell into a cancer cell It is now up to scientists at the cutting edge like Professors Wynford-Thomas and Lane to research why it is damaged and to develop treatments to restore its function."

Courtesy · Spectrum

New Light on the Structure of Electron

A group of physicists led by David Koltick, Professor of Physics at Purdue University, has suggested that an electron may not be exactly what it is thought to be since its discovery about 100 years ago. Measurement undertaken by the team of researchers has indicated that the electron may not be a simple negative point charge, as scientists often describe it to be According to David Koltick, science and engineering students have learned for years that the electron has a constant electronic charge but now what they have observed provides enough evidence that it is not so. Koltick's research shows that the electromagnetic force from the electron i.e its electron strength, may increase towards its central core

The data gathered by Koltick suggests that the core of the electron is surrounded by a fuzzy "cloud" of virtual particles which continuously come in and go out of existence in pairs One of the particles in the pair is positively charged while the other is negatively charged The cloud surrounding the electron is polarized. This polarization occurs because the strong negative charge at the core "pushes" the negatively charged particle in a pair slightly farther away from the core than the positively charged particle The polarization is strongest towards the centre of the core. However, the polarized pairs essentially cancel out each other so that they do not "add" any net electric charge to the electron. But the cloud plays the key role in how the electromagnetic force from the electron is perceived

According to the researchers the cloud of virtual particles acts like a screen or curtain so as to shield the true value of the core. As one probes further into the cloud i e. gets closer and closer to the core charge, one 'sees' a gradual decrease in the shielding effect while more and more of the core becomes visible It implies that the electromagnetic force from the electron as a whole is not a constant but rather it becomes stronger and stronger as one goes through the cloud and gets closer to the core. This effect is not perceived because ordinarily an electron is looked into or studied from a relatively large distance and as a result one does not realize that the electron is being shielded

Satellite that helps the Blind Get Around More Easily

A navigational and orientation device, called MoBIC (Mobility of Blind and Elderly People Interacting with Computers), will increase the independent mobility of visually disabled people travelling in unknown environments.

The system, which operates in conjunction with satellites of the Global Positioning System (GPS), has just been unveiled by the University of Birmingham (U.K.) and is set to revolutionise the lives of thousands of blind people when trials have finished. The units could be on sale soon.

MoBIC harnesses satellite signals to computer data and passes prepared route directions to the user by the spoken word The synthesised voice instructions are fed from a back-pack to earphones A wrist-worn mini keyboard allows the user to check a position, destination or operate the equipment.

The route-planning system involves a personal computer with synthetic speech output and software that enables blind people to explore the electronic map and plan the optimum route to their destination before setting out

Satellites and the Global Positioning System give the longitude and latitude of a user's position to within a metre on the journey. The computer carried in the user's back-pack converts this data to a position on an electronic map of the locality, adding details of the area—bus stops, shop names and crossing points. The result is then transmitted as a synthesised voice that gives the exact location to the user

According to Dr Graeme Douglas, Research Fellow at Birmingham University's School of Education—one of a four-person team which has been working on the project for several years—precise details about the area, such as shop names and landmarks can also be added by sighted people who have walked the route with blind people in mind.

Courtesy . SPECTRUM

Calcium and Vitamin D Reduce Bone Loss in Elderly

The findings of a research study conducted by a team of researchers at the Tufts University, USA, may help older persons fight against osteoporosis. Osteoporosis is a disease which often afflicts older men and women The bones of the persons suffering from this disease gradually lose their strength and become fragile causing frequent fractures of bones.

Bess Dawson-Hughes, and colleagues of the Jean Meyer of the Department of Agriculture Human Nutrition Research Centre Aging at Tufts University, have reported that their research study has shown that supplements of calcium and vitamin D can significantly reduce bone loss and the risk of fractures in older people. The research shows for the first time that these supplements can help older people fight osteoporosis The research also demonstrates that the benefits of these low cost and easily available supplement can be maintained over several years

According to Dawson-Hughes older people can benefit from this therapy at essentially no risk and at low cost The research underscores the importance of calcium and vitamin D supplementation in helping healthy and active older people stay that way The study also reveals that the osteoporosis is not just a women's problem as has been believed until recently. The study notes that older men do experience considerable bone loss with advancing age. With older people living longer than ever, increasing the intake of calcium and vitamin D can be an important lifelong strategy for both sexes

A combination of calcium and vitamin D was chosen by the researchers in keeping with the recommended doses of dietary requirements for these two nutrients. The researchers also took advantage of the fact that the vitamins influence the body in absorbing and utilizing calcium. It has been known that as the people age their capacity to absorb calcium and perhaps also vitamin D declines The production of vitamin D by the skin is known to decrease with age This reduced ability to absorb calcium contributes to bone loss as people age and the low bone density is the major cause of increased hip fractures among elderly

The participants of the study included a total of 389 men and women over 65 years They were kept in their normal diet for the period of study stretching over three years However, half of the study participants were given placebo pills having no nutritional value everyday before going to bed The other half were given two separate pills one containing elemental calcium and the other vitamin D. The bone mineral density and other tests were conducted on all participants once in every six months for the entire period of the study

The results indicated that the calcium/vitamin group lost significantly less total body bone and in some area gained bone mineral density The arrest in the rate of bone density was more pronounced in men who recorded a one per cent increase while a one per cent loss was detected amongst those kept on placebo pills.

According to Dawson-Hughes, the supplement may be effective in maintaining the overall body skeleton in addition to checking the bone density losses The research study also showed that calcium/vitamin supplement were beneficial to bone density at the hip, spine and total body which progressively increased during the period of the study

Galileo Visits Callisto Again

The US spacecraft Galileo orbiting the Jupiter made yet another closer approach of the Jupiter's moon Callisto on September 17, 1997 With a diameter of 4,800 km Callisto is the third largest natural satellite in the solar system It is the outermost of the four satellites of the Jupiter—other three being

Ganymede, Io and Europa—Galileo is scheduled to visit. It is the outermost of these satellites and orbits beyond Jupiter's main radiation belts.

Callisto has the lowest density among the four satellites which is 1 86 g/cm^3 No atmosphere has been observed on Callisto. Its interior is probably similar to that of Ganymede except the inner rocky core is smaller, and this core is surrounded by a large icy mantle. Callisto's surface is darkest amongst the four satellites but it twice as bright as our own moon

The first close images of Callisto were taken by an earlier US satellite Voyager 2 which went past Jupiter in 1979 It is the most cratered object in the solar system. It is thought to be long dead world, with a nearly complete absence of any geological activity on its surface In fact, Callisto is the only body greater than 1000 km in the solar system that has shown no signs of undergoing any extensive resurfacing since impacts have not molded its surface. A surface age of 4 billion years, Callisto has the oldest landscape in the solar system

There are no mountains on Callisto, which is probably due the icy nature of the satellite's surface. The surface features are dominated by impact craters and rings, and the craters are quite shallow There are two large "bullseye' structures on Callisto, thought to be the result of a massive impact. The largest structure, Valhalla, has a bright patch 600 km across with rings extending out to almost 3000 km The other ring structure, Asgard, is about 1600 km in diameter.

Seven impact crater chains have been mapped on Callisto by the Galileo mission in 1996 These chains probably formed when fragments of a comet were split by Jupiter's gravity and impacted on Callisto. In a similar scenario, Comet Shoemaker-Levy 9 split into 21 fragments and impacted Jupiter in 1994 It may be recalled that the death of the co-discoverer of this Comet, Eugene Shoemaker was reported in September 1997 issue of this journal

Light Relief for Back Pain Sufferers

A British orthopaedic surgeon, Mr. Martin Knight, founder of the charity, the Spinal Foundation, demonstrates his new method of treating patients suffering from back pain.

The new technique, called endoscopic laser foraminoplasty (ELF), which is based on keyhole and laser-light surgery, has been developed by the Foundation to deal with scarring, discbulging and overgrowth of the joints

Treatment for the relief of back pain until now may have involved cutting away bone, followed by long periods of physiotherapy. Rehabilitation can take up to 18 months and surgery sometimes leaves scarring around the sciatic nerve. It can also lead to degeneration in the discs between the vertebrae

The new treatment, which is particularly effective for people whose conventional back treatment has failed, obviates the need for them to undergo further surgery

One cause of lower back pain and

sciatica is the narrowing of the hole through which the sciatic nerve leaves the spine As the hole grows smaller, the disc grows back-wards and the joint thickens to become arthritic.

'Keyhole' surgery allows the spine to be entered through a tiny incision. The hole through which the nerve leaves the spinal canal is enlarged by the laser which also removes old scar tissue, another cause of back pain. The new treatment brings immediate pain relief and hastens dramatically the patient's return to a normal life It is generating wide interest, particularly in the USA and Europe

Courtesy · SPECTRUM

Three Dimensional Structure of Gene-engineering Enzyme Uncovered

A team of researchers led by Gregory D. Van Duyne, Assistant Professor of Biochemistry and Biophysics at the University of Pennsylvania Medical Center, USA have been able to determine the molecular structure of an important enzyme used in genetically engineering models for studies of human diseases It is envisaged that the new knowledge about the three dimensional arrangement of the protein known as Cre recombinase, will ultimately lead to better designs of engineering models

Cre recombinase is a type of protein which belongs to a family of proteins used by bacteriophages. Bacteriophages are viruses that infect bacteria i e. these are proteins which contain a bacteria as well as a virus Phages use these enzymes to splice their own genes in and out of the host bacterial genome. It enables them to retain their own genetic integrity during bacterial replication Scientists have been trying for a long time to find out a structural model of this enzyme to determine its linkages with the vast volumes of data concerning biochemical and genetic material amassed by them over the last several years They were keen to see what one of these recombinases looks like when it is bound to deoxyribose nucleic acid (DNA). Now, the researchers have not only been successful in binding it to its DNA subtrate, but have also trapped it after it has completed one step on the recombination reaction Using special techniques of cutting and splicing together genetic material from different sources, the researchers were able to stop the process of recombination at an early step which has enabled them to see its three dimensional structure This is for the first time that it had been possible to get a complete three dimensional picture of even one step of this complicated reaction

The Cre recombinase's splicing mechanism do not require any additional enzymes and it can be carried all alone. This simplicity makes it one of the most suitable amongst the proteins that could be used extensively in genetic engineering It is expected that by understanding the mechanism how Cre identifies the specific site on the DNA that it is supposed to cut, the molecular biologists will be able to improve genetic control of transgenic animal models In addition to the practical advances this detailed structural picture will provide, the discovery also provides very strong support to the recently proposed new way of looking at how recombination occurs.

Are Smog, Smoke and Sea Spray Delaying Greenhouse Warming?

Some 200 scientists from Europe and the United States joined forces this summer to investigate how smog, smoke and other "atmospheric aerosols" affect climate and the extent to which they may offset the "greenhouse" warming effect

"Atmospheric aerosols are tiny particles or droplets, most of them smaller than one micrometer in diameter, that are suspended in the atmosphere," noted principal scientist Timothy Bates of the Commerce Department's National Oceanic and Atmospheric Administration's Pacific Marine Environmental Laboratory in Seattle, Washington.

He noted that "the effect of these particles on radiation has been known for many decades, as they are responsible for colorful sunsets, hazes over the landscape and the less romantic smog in large cities. Only recently have scientists suspected these effects might also influence global climate."

Bates added that "the global distribution of aerosols, their characteristics and the way they interact with solar radiation and clouds are all poorly known, which prevents both precise calculations of the effect of aerosols on climate and accurate predictions of future climate change."

Man-made sources of atmospheric aerosols include smoke and fumes from industrial combustion, forest fires and automobile emissions. Natural sources include mineral dust, which is often transported over large distances, salt particles from sea spray, sulfur and other organic emissions from the ocean and land, and sulfur from volcanoes.

In the 2nd Aerosol Characterization Experiment (ACE-2) June 16-July 25, 1997 scientists within the International Global Atmospheric Chemistry Project equipped a ship, and coastal and mountain top sites in Portugal, the Canary Islands and Madeira with the most advanced observational equipment to study man-made aerosols from Europe and natural dust aerosols from the Sahara Research aircraft performed dedicated flights to make measurements within these aerosol plumes and the surrounding clouds. The area was also monitored with satellites

"The various measurements we make in ACE-2 can be considered parts of a complex puzzle, which scientists from around the world will piece together to explain the role of aerosols, particularly those produced by humankind, in climate change," Bates said

Aerosol particles primarily reflect sunlight and can also enhance their reflective properties of clouds, both of which result in a cooling of the Earth system Scientists believe that the cooling by aerosols may explain why the observed increase in the global temperature is lower than that calculated by climate models considering the greenhouse effect alone.

In an earlier experiment called ACE-1 in late 1995, scientists made similar measurements over the Pacific Ocean south of Australia, which is the least polluted area of the world and where the natural aerosol system could be studied in near-pristine conditions.

ACE-3 is planned for the year 2000 and will focus on rapidly increasing pollution sources in eastern Asia

Courtesy · SCIENCE UPDATE

Plastic Challenges Concrete

A new research network to explore the growing interest in fibre-reinforced polymer materials to replace concrete in the construction industry has been set up by engineers at Warwick University, U K. Already such materials have gained acceptances in bridge and building infrastructure renewals, pedestrian access structures, piping for offshore facilities and in the construction of chemical and petrochemical plant.

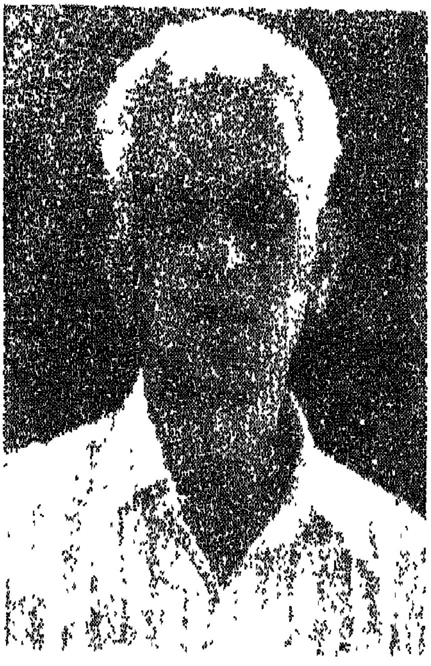
Further developments in their use by the building industry are likely to include timber and composite combinations and replacing concrete for reinforcement and permanent form-work, renewal and repair, prestressing and enclosure skins for steel structures.

The setting up of the network will focus and coordinate research in universities and the industrial sector on further developments and uses for composites as recommended by the UK government's Construction Report and the Engineering and Physical Sciences Research Council

Advances in the manufacturing of fibre reinforced plastic composites have combined with several developments outside the industry to make use of this type of material more attractive. Among building industry requirements are materials that have excellent corrosion resistance and are light weight; the need to be able to cost structures over their whole life rather than at the point of construction, and the reduced demand for Aramid and carbon fibres in the high-priced defence sector which has led to the greater exploitation of polymer materials. Designs of structures using composites have also improved and show that technical efficiency can be achieved within competitive constraints

Courtesy : SPECTRUM

Obituary



Shri P S Shankar a member of the Editorial Advisory Board of the quarterly journal *School Science* passed away on 27 August 1997 after a brief illness Born on 23 August 1929 at Bangalore, Shri Shankar did his M Sc (Organic Chemistry) in 1953 from the Mysore University After teaching for three years in colleges affiliated to the Kerala University and the Mysore University, respectively, he joined the Indian Institute of Technology, Kharagpur to pursue a career in research Later, he moved to the Central Road Research Institute New Delhi and finally in 1968 to the Publication and Information Directorate, CSIR from where he retired after completing a distinguished service of over 26 years

Soft spoken and mild mannered Shri Shankar established himself as an expert in the field of scientific and technical writing and editing. He contributed a large number of research papers, articles on a variety of science and technology related topics apart from editing science journals, periodicals and newsletters As a member of the Editorial Advisory Board of the quarterly *School Science*, Shri Shankar made many valuable suggestions for further improvement of the journal His positive attitude towards work and responsibilities had won him many friends The family of *School Science* deeply mourns the sad demise of Shri Shankar In his death a valuable friend and well-wisher of the journal has been lost May his soul rest in peace

GANDHIJI'S TALISMAN

"I will give you a talisman. Whenever you are in doubt or when the self becomes too much with you, apply the following test :

Recall the face of the poorest and the weakest man whom you may have seen and ask yourself if the step you contemplate is going to be of any use to him. Will he gain anything by it ? Will it restore him to a control over his own life and destiny ? In other words, will it lead to Swaraj for the hungry and spiritually starving millions ?

Then you will find your doubts and your self melting away."

mkGandhi

SCIENCE RELATED VALUES

Curiosity, quest for knowledge, objectivity, honesty and truthfulness, courage to question, systematic reasoning, acceptance after proof/verification, open-mindedness, search for perfection and team spirit are some of the basic values related to science. The processes of science, which help in searching the truth about nature and its phenomena are characterised by these values. Science aims at explaining things and events. Therefore to learn and practise science :

- Be inquisitive about things and events around you.
- Have the courage to question beliefs and practices.
- Ask 'what', 'how' and 'why' and find your answers by critically observing, experimenting, consulting, discussing and reasoning.
- Record honestly your observations and experimental results in your laboratory or outside it.
- Repeat experiments carefully and systematically if required, but do not manipulate your results under any circumstance.
- Be guided by facts, reasons and logic. Do not be biased in one way or the other.
- Aspire to make new discoveries and inventions by sustained and dedicated work.

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